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Forthcoming Events.

DECEMBER 7.

Institute of Metals (North-East Coast Local Section):—Meeting at Newcastle-on-Tyne. "Foundry Work." Paper by A. Logan.

DECEMBER 7-8.

Institution of Fuel Technology:—Meeting in London. Presidential address by Sir Alfred Mond.

Institute of British Foundrymen.

DECEMBER 4.

Lancashire Branch:—Ordinary meeting at Manchester. "The Commercial Aspect of the Foundry." Paper by J. Wolstenholme, Radcliffe.

London Branch:—Annual dinner at Engineers' Club, London.

DECEMBER 9.

London Branch:—Joint meeting with Institute of Metals. "Contraction and Alloy Casting." Paper by H. C. Dews.

DECEMBER 11.

Scottish Branch:—Joint meeting at Glasgow, for the annual dinner.

Birmingham, Coventry and West Midlands Branch:—Ordinary meeting at Birmingham. "Oil, Sand, and Motor Castings." Paper by W. West.

Newcastle-on-Tyne Branch:—Ordinary meeting at Newcastle-on-Tyne. "Manufacture of Iron Castings for Petrol Engines." Paper by W. J. Molineux.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Brass Tacks.

Mr. C. H. Ridsdale, in a Paper read before the Middlesbrough section of the Institute of British Foundrymen, complained of the inability of many lecturers to use terms which can be readily absorbed by the man in the works. We are convinced that so far as the iron, steel, brass and bronze foundries are concerned, a maximum utilisation of elementary chemistry and physics has not so far taken place. Whilst we are most enthusiastics for the general application of science in the foundry, we are just a little afraid that if too many dissertations on space-lattice and the structure of the atom are given, the enthusiasm of the man who has only been able to supplement a primary school education with a few years at the local technical college will be damped. There is so much to be effected by the application of elementary chemical arithmetic, that it can be definitely stated that an eighty per cent. finished material control can be affected by its application. The control of metal and sands is purely a junction of this phase of science. Whilst it is too late to alter the existing state of affairs, we consider it is rather a pity that such words as pearlite, cementite, hardenite, martensite and austenite have crept into foundry technology, and if these could have been termed the A, B, C, etc., constituents, it would have helped to procure a clearer conception of the internal structure of cast iron. The alpha, beta, gamma and delta designations which have become associated with the copper alloys are, to our mind, preferable.

Microscopy is becoming every day more important to the industry, and this, too, is better when regarded in its simpler aspects. It must be borne in mind, as Mr. Ridsdale points out, that the study of the lower magnifications gives more information of a practical character. For instance, pearlite, when examined at comparatively low magnifications, shows it to be one constituent, but at the highest it is shown to consist of alternate plates of cementite and ferrite. The former conception is more allied to practice, and when studied in conjunction with the actual pin point magnifications impresses upon the student the relative dimensions of the material under examination.

Since such lessons as have been given by Messrs. Ridsdale, Gresty, Logan and Fletcher from time to time to foundry audiences are designed for practical foundrymen that we hope that this class will come forward and say just how much of these lectures they can assimilate, as we are half afraid that the stumbling block is a lack of knowledge of elementary, chemistry and physics. It must be appreciated that neither the Institute nor the FOUNDRY TRADE JOURNAL can teach these subjects, but if they can arouse sufficient interest in technical subjects to fill the various evening classes devoted to these studies excellent work will have been an accomplishment.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

International Foundry Convention Chaos.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read in THE FOUNDRY TRADE JOURNAL of November 7 your editorial appearing under the above title. It would appear from what you write that the chaos on the conventions and exhibitions is more evident than had been thought.

I would remind you that the question of exhibitions and conventions on an international basis was taken up at the luncheon offered by Mr. Oliver Stubbs in Birmingham, in June, 1922, at my suggestion.

At this time my company had to exhibit at *three places at the same time*—namely, Birmingham, Liége, and Lyons—which, of course, means not only considerable expenses, but enormous complications of work. I suggested that the various foundry organisations of Europe could easily arrange to have one exhibition every year in different countries. At this time Germany was not taken into consideration, and it was proposed to have two exhibitions every five years in Great Britain, two every five years in the countries associated with the French Association, and one every five years in Belgium.

Difficulties, however, arose in connection with Great Britain, owing to the fact that the articles of association of the Institute of British Foundrymen prevented it from organising or taking part in any exhibition, according to the rules laid down in their Royal Charter. On the other hand, at this time a provincial authority in Great Britain was endeavouring to hold foundry exhibitions when and where it pleased or suited it to do so, without regard to the general wishes of the foundry trade.

This, in my opinion, was a grave mistake, but I understand that, as far as the foundry trade in Great Britain is concerned, you have cleared up this difficulty by the formation of a new Foundry Equipment and Supplies Association, which Association has been formed in order to consider the place and time where foundry exhibitions should take place.

To return to Mr. Stubbs' luncheon in Birmingham, it was not intended, in my first suggtstion, that the U.S.A. should be introduced into the problem, but my friend, Mr. H. Cole Estep, who was present, mentioned that, should the 1923 proposed convention, to be held in Paris, be considered as international, America would be glad to join in, having in mind, at this particular time, that the annual American exhibition would not be discontinued.

The 1913 Paris Exhibition may be considered to have been, in a way, the first international, as not only the Paris Association Technique de Fonderie includes in its membership people from various countries, but also because exhibitors from numerous countries were included, and, finally, owing to the many foreign visitors who were present at this convention. But it may be understood that the 1913 convention was not the result of an international understanding, and, consequently, it may be said that the Paris 1923 Convention should be considered as the first international foundry convention, and the 1926 Detroit meeting as the second international Convention.

Coming to the future, it would appear that, in the mind of many people, it should be agreed that such meetings should take place every three years. It may be pointed out, however, that the men on whom the success or the failure of such gatherings largely depend upon—namely, the exhibitors—have not been consulted.

May I suggest that a three years' period seems to be too long and especially if the U.S.A. are to be included in the arrangements. This would mean that, taking only four European countries, the turn of each would come only every fifteen years. I suggest that an exhibition or convention having an international character should be held in Europe every two years by the three principal associations—namely, Great Britain, Germany (with German-speaking countries), and Latin countries, leaving U.S.A. out of the question.

This would mean that the International Convention coupled with Exhibition would be held every six years in each group, the U.S.A. having to arrange an International Congress at about the same distance, but to be held one year when no European international gathering was taking place. If it would be possible to come to arrangements on such lines as the above, the exhibitors would have to make one great effort only every two years; this is a sufficient lapse to show progress on previous exhibitions.

I should also like to point out that similar suggestions have been accepted in U.S.A. as practical in that way, that exhibitions are to be held there every two years. Finally, I would emphasise that this would not prevent any or every country from holding their ordinary business or technical meetings.—I am, Sir, yours, etc.,

E. RONCERAY.

Sté. Anonyme des Etablissements,
Ph. Bonvillain & E. Ronceray,
Choisy le Roi, Paris.
November 24, 1926.

Mica Schists.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Referring to the letter from Mr. T. H. Gray appearing in your last issue, may I suggest that this gentleman has perhaps misunderstood the statement of your Special Correspondent that a refractory member of the Overseas Deputation had no previous idea that his deposits of a similar material at home had any refractory value. Most of the mica schists occurring in Great Britain appear to be of little use as refractory materials, either for cupola lining or other purposes, but it does not necessarily follow that *all* the occurrences are similarly useless. It seems likely that the refractory member referred to was surprised at the similarity of the American mica schist to his home deposits, and this incidentally provides a good illustration of the value of Overseas visits, as despite your correspondent's poor opinion of mica schist as a cupola lining, there is no doubt that good results are being obtained with it in a number of American foundries. As with other materials, its durability no doubt depends both on proper selection and proper application of the raw material.

In cupola linings other properties (such as, for example, volume stability and resistance to erosion and corrosion) are important as well as actual refractoriness, and it appears that, under some conditions of cupola practice, materials in which high refractoriness is sacrificed in order to obtain other desired working properties, give good results. If, however, a lining material is used which combines both high refractoriness and the other desirable properties, then its durability will be correspondingly greater. As a result of my own experience and investigations, I would suggest to foundrymen that the cupola lining material which is most durable and most generally applicable to the varying conditions of cupola practice is that produced from selected and graded ganister of the Sheffield district, or from raw material of comparable physical and chemical characteristics.—Yours, etc.,

W. J. REES.

University of Sheffield
Department of Refractory Materials,
Department of Applied Science,
St. George's Square, Sheffield.
November 27, 1926.

Catalogue Received.

Core and Enamelling Stoves. The Monometer Company, Limited, of Savoy House, 115-116, Strand, London, W.C.2, have sent us a four-page leaflet describing and illustrating a series of gas-fired furnaces. A feature which will appeal to foundrymen is that the castings forming the carcase are made of special cast iron, and are made in sections having ribs to prevent growth and cracking. The core stove illustrated has an automatic heat regulator and is double cased.

Applying Science in the Foundry.

By C. H. Ridsdale, F.I.C., F.C.S.

At a preliminary meeting last March (27th) a good deal was said about the great advance made in foundry practice by firms who had adopted scientific methods, that this would have to become general, and those who did not adopt them would inevitably go under.

But what exactly does adopting scientific methods mean? Are our ideas on this matter clear, or are some essentials missed? Foundrymen generally will agree that they must not proceed with manufacture in a haphazard way, accepting any product which results with a feeling, if it is good, that they cannot be sure of doing exactly the same again, and if bad, that they cannot help it—foundrymen must be able to control the chemical and physical forces, and direct them so that they give the results we want time after time with certainty.

To achieve this, one must understand the principles that govern them, or at least know that by following a certain course a certain effect is produced.

But, further, foundrymen must practice their knowledge. And, quite as essential as the more technical part of science is the use of system in daily working. Founders must not hoodwink themselves that results can be depended on to come out right if they are not exact in their proceedings every time. Obviously, this implies team work, and is more willingly carried out if all who are engaged in it know enough about it to appreciate the necessity of what they are told to do.

Early Beginnings.

Certain fundamental facts should be understood, and the author trusts therefore that those who do know all about them will be tolerant if these remarks are addressed to those who are not familiar with metallurgy and try to give them a few general conceptions which may be helpful to them in as simple a way as possible, even though they may be thought unorthodox and inexact, and also a general outline of how present-day foundry science has arisen.

Personal experiences date back to when there was comparatively little science as it is now known either in iron or steel making, or in foundry work. The adoption of analytical chemistry was in its infancy, and of micro work in these spheres there was none. Consequently, the author has watched the growth of chemistry, the birth of metallurgical microscopy, the discovery of many facts, the launching (or letting loose, if you prefer it) of many theories, the creation of new phraseology, and, in short, the entry of the Academic School into the domain of industrial metallurgy.

Broadly speaking, the scientists in those days who found out the facts about iron and steel were chemists. The terms metallurgist and physicist were practically unknown.

Most of these chemists were not university men, but had been trained up amid works practice, and consequently their scientific work and papers were permeated with the spirit of practice, and their language was fairly simple and intelligible to works people.

With the multiplication of universities and technical colleges, run in the main by professors whose training has been essentially academical, a new phraseology, in which Greek and Latin letters and words are very much to the fore, and new modes of expression by diagrams, "curves," and formulæ sprang up.

All this no doubt is natural to them, but often obscures their meaning to others. From many expressions of opinion—some of them very strong—this is a real grievance, and there is a decline of interest in the meetings and proceedings of certain societies that used to have the name for being practical, because too much prominence is given to abstruse theoretical and controversial papers and discussions.

Modern Scientific Language Difficulties.

And how many of the most prolific writers and speakers are really practical men? This is a much abused term. Should not one to merit it have been responsible in the fullest sense for a long period for production under commercial conditions?

One often sees it recommended that a student at a technical college should spend a portion of his vacation in a foundry or other works, and this, of course, is instructive and useful to him. But does this constitute him a practical man? Much has been said recently by men whose eminence as scientists gives weight to their words against modern modes of expression.

For instance, Mr. H. E. Armstrong ("Proceedings of the Institute of Chemistry," February, 1925, page 43) says:—"In and out of season of late years I have protested against our scientific jargon. We use a language which the public cannot understand; we do not even understand it ourselves."

With reference to a term, he says:—"I can't find it in the dictionary. Apparently our modern young chemists cannot use penny-plain, but only twopenny-coloured language." And again on p. 47: "While always coining new words, the world scientific to-day is strangely oblivious of the meaning of words." Again, Mr. T. J. Kennedy, chairman of the Cold Rolled Brass and Copper Association, speaking at the annual luncheon of the British Non-Ferrous Metals Research Association, expressed the opinion that "some of the research workers' reports, whilst doubtlessly very valuable, were, because of their scientific 'jargon,' as unintelligible to the average business man as they would be if they were addressed to him in Russian.

"The language of pure and applied science is becoming complicated and specialised with a rapidity that is truly alarming. New words and phrases are coined and applied often, we fear, with little provocation, and frequently with disrespect, both to the rules of etymology and the dictates of self-explanation.

"To label a characteristic with some new name rather than to resolve it in terms of familiar conceptions seems at times to be the research workers' object . . . those engaged in metallurgical research are not among the least blameworthy.

"At Tuesday's meeting Mr. Thomas Bolton, the Chairman of the Research Association, said 'the services of scientific men will be required in the near future to do nothing else but interpret the reports of the research workers for the benefit of their employers. Without their services . . . much of the research work . . . will end . . . in a cloud of words wholly without meaning, and therefore without interest, to those for whose good and at whose expense it is being conducted."

Again, a leader in the technical Press said:—

"We have become myopic through too intense study of phrase diagrams and phrase hieroglyphics. We must mix common sense with our science. There were intellectual giants about in Great Britain in the 'fifties, despite their meagre libraries and their poorly equipped laboratories. Are we as a nation . . . becoming too theoretical and less practical?"

Although the author has watched present-day metallurgy develop and followed it (as far as possible) from when it first appeared, and is continually reading the latest papers, there are times when he can himself hardly recognise their meaning, and he is told that only those who have gone through a modern university course can.

On several occasions, after struggling through some paper in which what purported to be a newly discovered fact was put forward—and no doubt it was to the writer—it has been found that after all it was some fact well known to myself, and no doubt to many others, thirty or forty years ago, but presented with such verbiage and described in such language as to be not recognisable. Some people appear to believe the more mystifying the manner in which they present a fact the more the public will be impressed.

XUM

As in Gilbert & Sullivan's well-known opera, "Patience":—

"If this young man expresses himself in terms
too deep for me,
Why what a singularly clever young man this
clever young man must be."

Do they want to create this impression, or are they only ignorant of how to express themselves plainly? It is axiomatic that really clever men expressed things in simple language that anyone could understand, and the cleverer the man the simpler the language. This fondness for the use of too-learned language is nothing new. St. Paul had to take this matter up with some of those who had received the gift of tongues, for he says in the 12th chapter of 1st Corinthians, v. 5: "If I come unto you speaking with tongues what shall I profit you?" and v. 19: "I had rather speak five words with my understanding, that by my voice I might teach others also, than ten thousand words in an unknown tongue."

It is not desired to be destructively critical, and it might be contended that those who do not understand this language should learn it. This is all very well, but the men most given to the use of this language will not come into the foundries and make the castings, whilst the managers, foremen and workmen, who have to do this, have neither the facilities nor the time to catch up with all these matters.

Then, must these men who have so much sound practical knowledge and experience remain unable to understand and apply the science of the matter? Not a bit of it. The essential scientific facts are not half so numerous or difficult to understand as the complicated phraseology and controversial theories put forward seem to imply.

To indicate very briefly a few fundamentals that we must bear in mind and work on all the time:—

First, the foundry is intended for the production *at a profit* of castings having a selection of various properties, such as *soundness*, including absence of blowholes, porosity, scabs, contraction cracks, etc.

Soundness is placed first, because in these days, when castings of higher strength iron are cut down in thickness proportionately to reduce the weight, it is obvious that the weakening effect of blowholes or other flaws of any given area is serious, whilst if known to be unsound, and rejected, its other properties do not matter.

Easy machineability, including homogeneity and absence of hard or soft spots; *strength* to resist static or varying mobile stresses, in compression, tension, or transversely (which involves both), at high, normal, or low temperatures, or under sudden variations of temperature.

Toughness, or power to resist shock; and into this category come malleable castings, whether of the white or black-heart variety; *hardness and rigidity; resistance to wear; softness; resistance to corrosion*, and many others which will occur to practical men.

The attainment of each of these brings other requirements such as fluidity, freedom from gas, or oxide, in the metal as cast, suitable casting temperature, cooling rate, etc., and each has a bearing on the other. Many castings have to meet specifications of considerable severity which involve successfully standing tensile, transverse, impact, Brinell, and other tests.

Now, foundrymen cannot get all of these properties to the fullest extent, to get any to a much increased degree diminishes one or more of the others, so one has to regulate one's selections so as to get the best practicable balance of advantages.

The degree to which a casting has these properties depends not only on its ultimate *chemical composition*, that is to say, on the quantity of each of the elements present, but on its *constitution*, namely, the way in which those elements are combined with each other to form primary compounds, and the structural arrangement of these bodies, that is the way in which they are distributed, and the forms they take, whilst apart from the foregoing, there are other influences such as grain size, the thickness of grain boundaries, segregation, blowholes or other faults, etc., all of which have an effect.

(*To be continued.*)

The Iron and Steel Institute.

Autumn Meeting, 1927.

The Institute having received an invitation from the Canadian Institute of Mining and Metallurgy to hold a joint meeting with that Institute at Montreal, in the latter part of August, 1927, it has been suggested that the meeting should take place simultaneously with the holding of the Empire Mining and Metallurgical Congress, for which arrangements are in progress.

All members attending the meeting are entitled to membership of the Empire Mining and Metallurgical Congress, the opening date of which is fixed for Monday, August 22, at Montreal. They can likewise take part, if they so desire, in the long-distance tour to Toronto, Winnipeg, and Vancouver, following the sessions at Montreal. Particulars of fares, etc., can be supplied on application.

The Williams Prize.

On his retirement from Hon. Treasurership of the Iron and Steel Institute, in May, 1926, Mr. Illtyd Williams generously presented to the Institute the amount of £3,000 stock of the 3½ per cent. Conversion Loan, the yearly interest of which is to be applied to the making of a money award for the best Paper of a practical character, presented to the Institute and accepted for publication at the annual or autumn meeting each year.

The award is to be known as "The Williams Prize," in commemoration of the late Mr. Edward Williams, father of Mr. Illtyd Williams, and Past-President of the Institute, and also in recognition by Mr. Illtyd Williams himself of the honour in having been elected to serve the Institute as Hon. Treasurer for a long period of years.

The award will be made at the discretion of the Council, under the following conditions:—

(1) The author of the Paper shall be a British subject, regularly employed in a British iron and/or steel works, or in a works situated in any British Dominion, and possessing blast furnaces and/or steel or iron melting furnaces. The author at the time of presenting the Paper shall be employed in such works in a position not superior to that of manager of any one technical department, such as blast furnaces, melting shop, rolling mills, foundry, etc. That is, he may be departmental manager, head foreman, roller, roll turner, melter, apprentice, etc. (2) The Paper or Papers must be of a practical character, bearing on the manufacture or treatment of iron and/or steel. (3) In the event of two Papers being submitted, and found to be of approximately equal merit, the Council may, at their discretion, divide the award between the two authors. (4) In the event that, of the Papers submitted in any one year, none is, in the opinion of the Council, deserving of any award, the Council may withhold the award in that year; and (5) if two or more qualified candidates collaborate in submitting a Paper, which is adjudged suitable for an award, the Council may divide the award among the joint authors.

Mr. H. H. Shephard has been appointed foundry manager and metallurgist to Crane-Bennett, Limited, of Nacton Works, Nacton Heath, Ipswich, who are establishing a blackheart malleable foundry for the manufacture of the well-known Crane-Bennett boiler-fitting specialities.

Failures of Boiler Steel.—In his report for the year 1925, just issued, Mr. C. E. Stromeyer (Chief Engineer of the Manchester Steam Users' Association) deals with numerous instances he has collected (since his Papers on the subject before the Iron and Steel Institute in 1907 and 1909) of failures of steel (mostly plates) with varying percentages of phosphorus and nitrogen, including a number undoubtedly due to contact with caustic while the metal was in a strained condition. He also deals with the question which has been raised as to the size of safety valves on steam pipes, and reports upon the shortening of a single tube in a nest of water tubes of a Babcock and Wilcox boiler. Accompanying the report is a memorandum on the use of oil fuel for steam boilers which we deal with elsewhere in this issue.

On the Malleable Cast Iron and the Mechanism of its Graphitisation.

By Tario Kikuta (Research Laboratory, Tobato Foundry Company, Tobato, Japan).

(*Continued from page* 466.)

Effect of Phosphorus.

The chemical analysis of specimens used and the results obtained in this test are shown in Table XVIII.

From the above table one can see that when both sulphur and phosphorus are present in white cast-iron, graphitisation takes place with greater difficulty than in the case when only one of these elements is present. If the effect of sulphur is kept out of consideration, phosphorus has a great effect on the first stage of graphitisation, but for the second stage there is a limit in the amount. For instance, the first stage of graphitisation for specimen No. 60 was effected completely in two hours and forty minutes at 925 deg., whilst in that of the second stage it did not occur at all, even after it was kept at 710 deg. for ten hours. Furthermore, white cast iron containing much phosphorus becomes very brittle, and from the above consideration it seems to the writer to be suitable to limit the phosphorus content to 0.30 per cent.

TABLE XVIII.

Sample No.	C.	Si.	Mn.	S.	P.	Time required to complete graphitisation.	
						First stage.	Second stage.
54	2.54	1.16	0.31	0.012	0.020	9*h* 20*m*	
56	2.54	1.13	0.22	0.022	0.212	6 0	11*h*
57	2.48	1.18	0.22	0.036	0.298	4 30	
58	2.40	1.14	0.22	0.039	0.451	4 0	9
59	2.48	1.12	0.21	0.065	0.623	7 0	
60	2.41	1.06	0.20	0.059	0.792	2 40	10+x*
61	2.43	1.06	0.20	0.087	1.044	11 30	
62	2.29	1.00	0.20	0.057	1.990	5 30	

* Specimen No. 60 did not exhibit the second stage of graphitisation at all, though it was heated to 710° for 10 hours.

SOME PRACTICAL TESTS.

Since the various effects on the graphitisation had been clear, the conditions for graphitisation which were proved best by the foregoing research were chosen, and some tests of the annealed specimen under these conditions were carried out. For this a cylindrical pot of white cast iron, 280 mm. wide, 410 mm. high, and 12.5 mm. thick was used, and in it many test pieces, whose chemical composition was known, were inserted with other test bars as well as castings of white cast iron, and these were packed with sand; the pot was then placed in a large electric furnace, the temperature of which was regulated by changing an electric current by means of a voltage regulator. The weight of the pot was 36.8 kg., the capacity about 52.5 kg. and the packing sand 22.5 kg. in weight. The temperature of the pot which was packed with articles was not distributed in perfect uniformity and it also required about 6 hours to conduct heat from the outside to the centre of the pot at the normal temperature (900 to 950 deg.). The results of tests are shown in Tables XIX to XXI. In addition to the data in the tables, the completion of graphitisation was inspected by breaking test bars after the heat treatment, but the result obtained is not shown here.

(1). The heat-treatment effected is as follows:—

For the upper part in the pot,

20°←10*h*→900°←10*h*→900°←14*h*→700°←8*h*→700°→12*h*→450°.

For the central and lower parts in the pot,

20°←10*h*→940°←10*h*→940°←14*h*→720°←8*h*→720°←12*h*→500°.

Next to the above, a further test was again carried out after changing the position of the pot in the furnace.

(2). The heat-treatment in this instance is as shown below:—

For the upper part in the pot,

20°←10*h*→900°←10*h*→900°←13*h*→690°←10*h*→690°←10*h*→470°.

For the central and lower parts in the pot,

20°←10*h*→930°←10*h*→930°←13*h*→705°←10*h*→705°←10*h*→500°.

In the heat-treatment of the above samples an attempt was made to shorten the time to a minimum range, so that, if the time given is more than that shown in the example, the graphitisation may result more satisfactorily. And if the second stage of graphitisation is not completed, that of the first stage, however, being complete, there remain large pearlitic areas in the matrix and the brittleness is greatly increased. The following heat treatment was next carried out.

TABLE XIX.

Sample No.	Position of specimen.	Chemical composition					Tensile test.		
		C	Si.	Mn.	S.	P.	Tensile strength in T/sq. in.	Elongation in %	State of fracture.
1R—1831 ...	Upper	2.80	0.89	0.21	0.039	0.096	27.5	1.0	White
" ...	"						28.3	1.0	"
6E— 261 ...	"	2.60	0.99	0.27	0.039	0.086	19.8	7.0	Black
" ...	"						21.2	9.0	"
1R—1830 ...	Lower	2.48	0.96	0.22	0.044	0.104	20.3	8.0	"
" ...	"						20.4	10.0	"
6E— 258 ...	"	2.30	1.21	0.25	0.035	0.094	22.5	16.0	"
" ...	"						22.7	17.6	"
1R—1532 ...	Centre	2.72	1.14	0.24	0.035	0.098	19.6	12.5	"
" ...	"						19.5	11.5	"
6E— 267 ...	"	2.73	1.36	0.28	0.030	0.100	18.9	10.0	"
" ...	"						19.4	10.0	"

(3). Heat-treatment for the upper part in the pot,

20°←10*h*→900°←12*h*→950°←6*h*→705°←5*h* 30*m*→575°;

For the central and lower parts in the pot,

20°←10*h*→930°←12*h*→980°←7*h* 30*m*→710°←4*h*→595°.

By this treatment, the graphitisation of the first stage in these specimens is always completed, but not the second stage, as shown in Table XXI.

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From these results, we can understand that in order to complete the second stage of graphitisation, it is essential to keep the articles at just below the A_{c1} transformation point for a long time, and also that it is more difficult to effect the second stage, as the content of carbon is decreased.

On the Growth of Malleable Cast Iron.

When malleable cast iron is repeatedly heated and cooled above and below the A_1 point, it grows gradually like a grey cast iron. At first, the rate of diffusion of carbon into γ iron at high temperature above the A_{c1} point in black-heart malleable cast iron was investigated. The chemical composition of specimens used in this experiment was C 2.56, Si 1.47 and Mn 0.27 per cent.

After the specimen had been completely graphitised, it was placed in a silica tube of the dilatometer and heated to 820 deg. or 920 deg. and kept at that temperature for various intervals of time; then, after being removed from the furnace, it was cooled rapidly in air with the specimen in the silica tube, and afterwards the degree of diffusion was examined microscopically. Judging by microstructures and dilatation-temperature curves, it is to be concluded that the small dilatation takes place during the time of exposure of the specimen at a temperature above the A_{c1} point, and also the greater inclination of curve above 800 deg. is due to the diffusion of temper carbon into γ iron.

When a specimen of malleable cast-iron is repeatedly heated and cooled at the A_1 range, it gradually grows as shown in Fig. 7. What causes the black-heart malleable cast iron to grow, or in other words to perform an irreversible expansion with the repeated heating and cooling? The microstructure of malleable cast iron principally consists of ferrite and many spots of temper carbon, which are scattered all over the ferrite matrix. When malleable cast iron is heated and attains a high temperature, the carbon diffuses into the α iron, which at once begins to convert itself into γ iron, from the boundary of the temper carbon and this reaction spreads gradually over the whole body. However, the diffusion cannot occur instantly, but requires a fairly long time to spread completely, so that the A_{c1} transformation cannot take place at the same time all over the material. In the part far away from the temper carbon, the dissolution of carbon to form a solid solution occurs later. Accordingly, the contraction is due to the A_{c1} transformation, which takes place in one part after another. The consequence is that at the A_{c1} point, the portion round the temper carbon undergoes a great tension in the form of a permanent yielding such as minute fissures or cracks. Consequently, the contraction at the A_{c1} range becomes less in amount than that of corresponding carbon steel at the A_{c1} point. This difference in dilatation forms the irreversible change which occurred during the heating. When malleable cast iron is cooled from 920 deg. after having absorbed carbon sufficiently, cementite separates from austenite along its solubility line as well as at the A_{r1} point and is decomposed into free carbon and ferrite, if the cooling is sufficiently slow. When cementite is decomposed into free carbon and ferrite, there occurs always a dilatation the amount of which is larger than that calculated from their specific volume data. This decomposition of eutectoid cementite does not take place at the same time all over the material, but it begins at the portion around the temper carbon and then spreads over the rest. Consequently, the portion where the temper carbon is present undergoes a great tension, resulting in some breaks taking place along the weak point of the temper carbon. In this way, numerous fissures are formed in portions, where specks of temper carbon are present, and hence the expansion during cooling through the A_{r1} range is irreversible. The cavities so formed will take a permanent set at high temperature; and thus the porositisation always progresses with repeated heating and cooling. These irreversible expansions which occur during heating and cooling above and below the A_1 transformation point are the principal cause of the growth in malleable cast iron. If a specimen, the chemical composition of which is C, 2.26; Si, 1.11; Mn, 0.24; S, 0.044, and P, 0.111 per cent., be heated and cooled fairly rapidly, the irreversible expansion can hardly take place during the second heating and also that due to the cooling is very small.

This case may be explained as follows: Since the decomposition of cementite separated from austenite along the solubility line is very small

TABLE XX

Sample No.	Position of specimen.	General composition					Tensile test.		
		C	Si.	Mn.	S.	P.	Tensile strength in T/sq. in.	Elongation in %	State of fracture.
2R—1547 ...	Upper	2.57	1.13	0.20	0.027	0.118	26.2	4.0	White
2R—1543 ...	,,	2.42	1.15	0.22	0.31	0.105	22.0	11.5	Black
5E— 635 ...	,,	2.35	1.27	0.30	0.039	0.102	23.4	11.0	,,
,, ...	,,						21.3	10.0	,,
2R—1547 ...	Centre	2.57	1.13	0.20	0.027	0.118	24.7	6.5	A defect
2R—1542 ...	,,	2.48	1.21	0.22	0.035	0.120	22.4	11.0	Black
6E— 317 ...	,,	2.37	1.40	0.27	0.037	0.090	22.0	9.0	,,
,, ...	,,						22.2	8.6	,,
5E— 633 ...	,,	2.43	1.31	0.34	0.037	0.086	21.9	6.4	,,*
2R—1542 ...	Lower	2.48	1.21	0.22	0.035	0.120	21.5	13.4	,,
2R—1543 ...	,,	2.42	1.15	0.22	0.031	0.105	20.4	13.0	,,
6E— 308 ...	,,	2.38	1.18	0.27	0.035	0.080	20.7	8.5	,,*
6E— 315 ...	,,	2.42	1.10	0.34	0.034	0.090	22.3	6.0	,,*

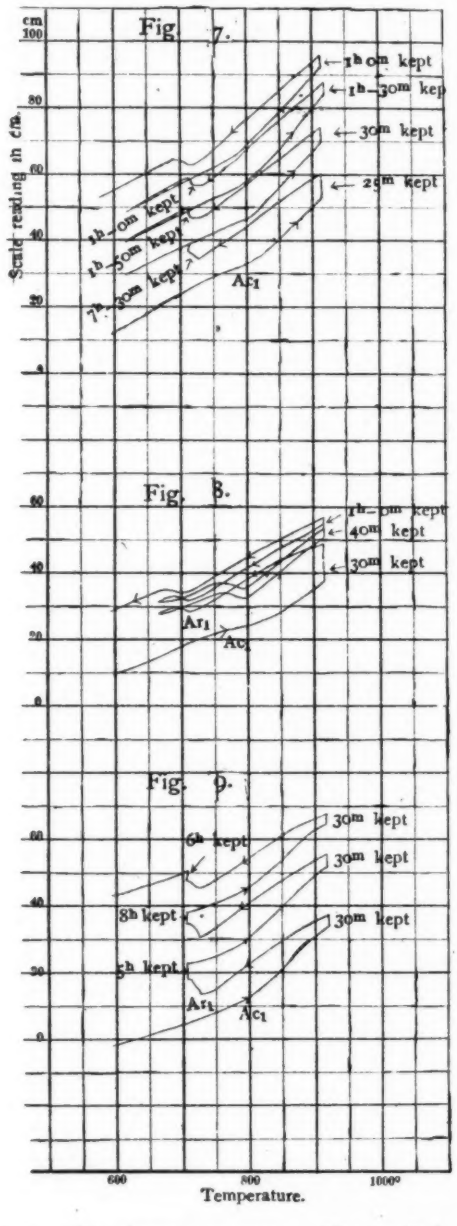
Mark * in the above table shows that the rupture of the specimen took place at the outside of the gauge length.

TABLE XXI.

Sample No.	Position of specimen.	General composition					Tensile test.		
		C	Si.	Mn.	S.	P.	Tensile strength in T/sq. in.	Elongation in %	State of fracture.
1R—1839 ...	Upper	2.55	1.14	0.20	0.034	0.096	29.2	3.5	White*
,, ...	,,	,,	,,	,,	,,	,,	28.1	4.5	,,
6E— 320 ...	,,	2.39	0.97	0.30	0.041	0.094	30.5	0.5	,,*
6E— 326 ...	,,	2.65	1.16	0.30	0.044	0.098	28.0	3.7	,,*
1R—1838 ...	Centre	2.58	1.08	0.21	0.031	0.097	28.3	1.2	,,*
,, ...	,,	,,	,,	,,	,,	,,	27.2	2.0	,,*
6E— 320 ...	,,	2.39	0.97	0.30	0.041	0.094	25.2	2.2	,,*
6E— 329 ...	,,	2.54	0.01	0.28	0.042	0.114	24.7	2.0	,,*
2R—1545 ...	Lower	2.35	1.18	0.17	0.030	0.126	28.1	2.8	,,
,, ...	,,	,,	,,	,,	,,	,,	26.7	1.0	,,*
6E— 326 ...	,,	2.65	1.16	0.30	0.044	0.098	24.3	3.0	,,
6E— 329 ...	,,	2.54	1.01	0.28	0.042	0.114	27.5	3.0	,,

Mark * in the above table shows that the rupture of the specimen took place at the outside of the gauge length.

because of the rapid cooling, the microstructure which is obtained below the A_{r1} point becomes pearlitic; hence in the second heating the A_{c1} transformation takes place uniformly in all parts of the specimen, the result being that hardly any



irreversible change can occur. The small irreversible expansions shown in Fig. 8 are probably due to a slight decomposition of cementite separated from austenite.

Further, annealed sample No. 4 was again heated and cooled very slowly as in the practical operation, that is,

the first heat-treatment,

700°←2*h*→925°, kept for 30*m*, ←2*h* 20*m*→700°, kept for 5*h*; the second heat-treatment,

710°←2*h*→925°, kept for 30*m*, ← 2*h* 20*m*→710°, kept for 8*h*; the third heat-treatment,

710°←2*h*→925°, kept for 30*m*, ←2*h* 20*m*→710°, kept for 6*h*.

In this case the specimen was kept constant at 710 deg. for a sufficiently long time in order to decompose the eutectoid cementite. Fig. 9 shows the manner in which the growth of the specimen takes place in the above heat-treatment; the irreversible expansion due to the decomposition of the eutectoid cementite gradually decreases at every repeated heating and cooling. It may probably be due to the fact that by repeated heating and cooling the porosity of the material is increased, and this accelerates the burning of carbon.

The Mechanism of Graphitisation of White Cast Iron.

The graphitisation of the iron-carbon alloys has already been studied by Professors K. Honda and T. Murakami, who concluded that the graphitisation is caused by the catalytic action of free carbon oxides, and the most effective temperature lies between the eutectic point and 1,100 deg. In the case of malleable cast iron the graphitisation takes place below 1,000 deg. in virtue of the presence of silicon, as well as the long heating, and is also affected very much by the content of various elements; hence in the presence of other elements it cannot be explained by the catalytic action of free carbon oxides only.

The beginning of graphitisation becomes more difficult as the content of sulphur is increased. Accordingly, it is possible that the catalytic action of free carbon oxide is more or less hindered with the increment of sulphur, although it combines with manganese or iron to form sulphides.

Summary.

The results of the present investigation may be summarised as follows:—

(1) In the investigation of graphitisation of white cast iron for obtaining black heart malleable cast iron it is desirable to carry out the graphitisation in two stages.

(2) In order to graphitise white cast iron completely, it is essential that after the completion of the graphitisation of the free cementite at a high temperature above the A_1 point, the article should be heated just below the A_{r1} point for a prolonged time or cooled very slowly from the A_{r1} range to decompose the eutectoid cementite.

(3) The graphitisations of the first and second stages are greatly affected by the annealing temperature, and the time required to complete them decreases logarithmically with the rise of temperature.

(4) There is an intimate relation between the thickness of the casting and the size of the free cementite, *i.e.*, the size of the free cementite grows as its thickness increases; and the graphitisation of the free cementite will become more difficult as its size becomes larger or the casting thicker.

(5) The tapping temperature of the melt also affects the graphitisation of white cast iron, and the graphitisation becomes more difficult as the temperature is raised.

(6) Silicon has a powerful effect on the graphitisation of the first and the second stages, and as this content is increased the time required to complete the graphitisation logarithmically decreases.

(7) For the second stages of graphitisation carbon is more effective than silicon, although it hardly affects that of the first stage.

(8) The action of manganese is to lessen the graphitisation, the effect being particularly great on that of the second stage, so that it is very important to limit its contents to below 0.5 per cent. in the case of the black heart malleable iron casting.

(9) The action of sulphur is to hinder the graphitisation like manganese, especially that of the second stage, and it is advisable to limit its content to 0.6 per cent. in practice.

(10) Phosphorus acts in assisting the graphitisation of the first stage, but for that of the second stage its content must not exceed 0.3 per cent.

(11) From the results of the present investigation some rapid heat-treatment of a practical sample has been tried, and it was possible to obtain black-heart malleable cast iron by heating white cast iron containing more than 2.5 per cent. of carbon and 1 per cent. of silicon for 54 hours.

(12) The black-heart malleable cast iron makes a growth with repeated heating and cooling through the A_1 transformation range as grey cast iron does; and the cause of this phenomenon is almost the same as in the case of grey cast iron.

(13) From the various phenomena studied in the present investigation the following conclusion regarding the mechanism of the graphitisation of white cast iron is drawn:—By means of the catalytic action of free carbon oxides present in the casting a nucleus of the graphitising temper carbon is formed principally along the boundary of the cementite, and the graphitisation which is to take place successively is accelerated by the affinity between the iron and the included elements.

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Demonstration Foundry Enlarged.

There are but few foundrymen in Great Britain who have not at some time or other spent an interesting hour or two in the foundry plant show-room at the Vulcan Works, Blackfriars Road, Manchester, of Messrs. J. W. Jackman & Company, Limited, but never since their opening has there been a more interesting display of machinery. The march of progress has brought into being many novel types of plant, which do not entirely replace existing models. Thus the firm have found it necessary to increase the size of the show-room to take care of these developments. We are not particularly enamoured of the word show-room, and perhaps demonstration plant would be more applicable, as the wide range of machines installed are all capable of being worked. One of the aims of the firm has been to gather under one roof a range of plant interesting alike to both large and small founder, and to do this adjacent to the manufacturing plant where visitors can see the machines being built and can criticise the workmanship.

On entering, the first group of machines to catch the eye are those devoted to sand preparing, all grouped together in one bay. Our representative was particularly struck with a new type of sand mill and mixer, which is quite different from any other make with which he is familiar. It is modern, inasmuch as it has a lightweight roller adjustable to give any desired pressure, or merely a roller-action on the sand; that the roller can be put completely out of action and the mill used as a mixer only; that it is self-delivering at one point over the side of the pan direct into a barrow, conveyor or other means of transport, yet it is in principle based on one of the oldest of machines, the common plough. By the insertion of special scrapers, the true plough action has been faithfully imitated.

A second fascinating machine for preparing sand is a new type of disintegrator blower. It is a direct motor-driven portable machine, which relies for the actual disintegration on centrifugal force. The sand is fed into a good wide hopper, fitted with a large mesh grid, and falls on a rapidly rotating plate carrying beaters. This not only causes a disintegration and aeration of the sand to be accomplished at high speed, but communicates such a speed to the sand that it leaves the machine in the form of a continuous stream which passes through a sieve, leaving scrap on one side and only permits of the passage of the prepared sand. The build of the machine allows of a variation of the angle of discharge to suit local conditions. Whilst we took no actual capacity test, we can readily believe that 5 tons per hour is no exaggeration. A range of various types of sand sifters operated by belt, compressed air and electricity completes a really interesting layout.

Metal Recovery.

The only real way of getting an interesting demonstration of the metal recovery units is for foundrymen to submit bulk samples. Not being so provided, we could but note the mechanical attributes of a ball cinder mill and a few types of magnetic separators.

Core Shop Equipment.

In this department are displayed various types of oil and core sand mixed, core-making machines and drying stoves.

Moulding Machines.

There is a range of twenty different types of moulding machines available for inspection, yet Mr. Rawlinson, our chaperone, insisted that in spite of this large number they were from time to time called upon to design new machines or modify existing ones for special purposes. The majority of the machines are built in the works, but a certain number of Osborns and Sissons-Lehmann are imported, all neatly set out in two rows. These machines include, amongst the hand-operated ones, those of the press type with a box-lifting arrangement; turnover table; rock-over and stripping plate machines. Of power machines, which, by the way, are all pneumatically-operated, we noted the plain press; the jolt press; plain jolters; a shockless jolter; and Osborn roll-over jolters.

Sand Blast Plant.

There is a definite recrudescence of interest in sand blast plant, and the range of machines exhibited is quite an imposing one. For large castings the clearing room must remain, but it is now so arranged that the operator is accommodated in a separate compartment, which, to our mind, is desirable from a humanitarian point of view. Then for the smaller sizes there is a choice between the cabinet and the rotary table. Of the latter there are two models, one being much more strongly built than the other to meet the requirements of the market. For quite small castings a new model sand blast barrel is shown. It is a self-contained piece of apparatus, complete with dust extractor, and so arranged that the abrasive and dust do not come into contact with the treads and rollers.

In conclusion, we congratulate the Manchester local directors, Messrs. Rawlinson and Garratt, in the excellent utilisation of the space available so as rapidly to provide visitors with a true conception of the worth of the machines they exploit and the service they can give.

Northern Coke Research Committee.

At the first meeting of the Northern Coke Research Committee, held at Armstrong College, Newcastle-upon-Tyne, Dr. Cecil A. Cochrane took the chair, and there were present also Major E. O. Henrici (Secretary of the Fuel Research Board), Mr. Paul List and Mr. E. Tosh (West Coast Blast Furnace Owners' Association), Major A. C. Scoular and Mr. D. R. Wattleworth (Cumberland Coal Owners' Association), Dr. Henry Peile (Durham Coal Owners' Association), Mr. A. H. Middleton and Mr. W. E. Mordecai (Coke Oven Managers' Association), Dr. L. Slater (Blast Furnace Coke Research Committee, Yorkshire and Derbyshire Coalfields), with Sir Theodore Morison, Professor Granville Poole (Armstrong College), Mr. E. C. Evans (organising secretary), and Professor H. V. A. Briscoe (secretary).

Letters were received from the Durham Coal Owners' Association promising £150 for the first twelve months, and from the Cleveland Ironmasters' Association stating that the local steel-making firms had agreed to contribute a further sum of £75. Consideration of the promises of financial support which had already been made by the industry and by Armstrong College, together with the expectations of further assistance from the Fuel Research Board, showed that the Committee had at its disposal funds sufficient to permit an immediate beginning of work upon the research programme. The Committee approved proposals to convert and equip as a research laboratory a vacant building in Armstrong College, and adopted a detailed research programme summarised in the statement that the work of the Committee shall be: "To apply laboratory tests of physical and chemical properties to typical cokes from the Northern Area, and to secure such samples, data, reports and other records as will serve, at the time or subsequently, to correlate the results of the tests with (1) the sources and nature of the raw coal; (2) the methods of coking; (3) the behaviour of the cokes in use in industry and as domestic fuel.

The Secretary and Professor Poole were given authority to proceed with the research scheme as staff and laboratory facilities became available.

Estimates of expenditure for the year 1926-27 were approved for submission to the Fuel Research Board.

At the conclusion of the meeting, Dr. Cochrane having informed the Committee that the pressure of other duties prevented his accepting the office of Chairman, on the motion of Mr. A. H. Middleton, seconded by Sir Theodore Morison, Dr. Henry Peile was unanimously elected to the chair.

Mr. C. A. Eberle, of Messrs. Wm. Kennedy & Sons, Limited, of Owen Sound, Ontario, Canada, is at present on a visit to this country. His firm manufacture manganese bronze propellors under an arrangement with Messrs. J. Stone & Company, Limited, of Deptford, grey iron, mild steel, black heart malleable, and manganese steel castings. About 70 moulders are employed in the foundries other than the malleable, which is an allied concern. Mr. Eberle is to be present at to-morrow's first annual dinner of the Foundry Supplies and Equipment Association at the Engineers' Club.

Labour Conditions in American Foundries.

At the November meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, held at the Engineers' Club, Waterloo Street, Birmingham, Mr. D. H. Wood, the President, in inviting Mr. J. T. Kay—an ironmoulder employed by a Birmingham firm—to give an address on labour conditions in American foundries, said they were making somewhat of a departure from the usual practice of having a scientific lecture. Members would recollect that in March of the present year a Commission was appointed, consisting of representatives of the eight engineering and allied trade unions, who, at the instance of the "Daily Mail," visited various foundries and works in the United States. They made as thorough an investigation as time permitted into the labour conditions prevailing, and how it was possible to pay the existing high rates of wages. They met not only the workmen, but the captains of industry, and were given every facility for gathering information which would be of advantage not only to the engineering trade, but to industry generally in this country.

MR. KAY said he did not propose to enter into technicalities, but would confine himself to a few general impressions of the visit. He realised that we in this country had not much to learn from the United States about the technicalities of the foundry, either on the metallurgical side or in many other respects. Nevertheless, on the other side of the Atlantic there was something that was different. Mr. Kay first described a visit to the works of the Neptune Meter Company in New York City, where he said the foundry was devoted to small work. There the labour-saving devices were extraordinary and the production simply incredible. When one realised the facilities provided, however, the results obtained were not so surprising after all. The machines were arranged on the merry-go-round principle, and he could not help comparing the conditions with those which prevailed in similar foundries in this country, where, with twice the amount of manual labour, the production would probably be only about half what it was at this works. The wages paid were to him staggering—between £9 and £10 a week. Piece-work as we knew it did not seem to be encouraged in the United States. At the works in question there was a kind of bonus scheme in operation, under which it was of advantage to the men if they produced more than was recognised as being the equivalent of a day's work. After looking over several other foundries in New York, the party went to see the works of the General Electric Company at Schenectady. Here, Mr. Kay said, he was more at home in the foundry, inasmuch as the class of work more closely approximated to that with which he had been accustomed. The foreman was a Lancashire man, and had been with the firm for thirty-eight years. The foundry was divided into three parts, in which were cast iron, steel, and non-ferrous metals. He was rather amused at the importance which seemed to be attached to the comparatively few aluminium castings turned out. They were quite ordinary castings, which would be made up a courtyard in Birmingham. In the iron foundry there was a large amount of big work passing through, but the striking feature to him was that there was little or no loam work. The foreman admitted that loam moulders in the United States were few and far between. They ran the risk of making things in sand which it would be far safer to make in loam. There appeared to be a scarcity of skilled moulders in the higher sense of the term, yet they got over the difficulty in different ways, which must have cost a considerable amount of money. In addition to a kind of premium bonus arrangement, the General Electric Company had a system of reward for long service which seemed to prevail throughout the industrial United States. When a man had worked with a firm for a certain period a percentage was added to his wages at the end of the year. This, of course, tended to keep men in the service of one company, to which the magnates of the United States attached very great importance. They regarded the shifting about of a man, to which we were accustomed in this country, as a positive tragedy, and at any cost they attempted to prevent it. Labour-saving plant was not so much in evidence in the large foundries as in the smaller. Nevertheless, pneumatic runners and other devices for assisting the jobbing moulder were in use, and the moulder took them as a matter of course. The moulders were kept purely on productive work. They did not employ a dollar-an-hour man on what could be done by a 35-cents-an-hour man. The firm had a wonderful welfare scheme. They had advanced something like 4½ million dollars to assist workmen to buy their own houses; they had a mutual benefit association, which distributed $100,000 a year in sick benefit; and there was also a life insurance scheme, the amount payable at death being in accordance with years of service. The general manager assured them that 14,700 piece prices were set last year, and that not one of them had been interfered with in any shape or form throughout the year.

Locomotive Production.

Mr. Kay next described the conditions obtaining at the American Locomotive Works, where he said the foundry was mainly piecework and where again the wages averaged from £9 to £10 a week. The class of labour employed was not of a very high standard, speaking from the skilled moulder's point of view, but nevertheless the output was simply staggering. With the exception of the locomotive cylinders everything seemed to be produced on jolting machines, and there was no regard to appearances. He was assured by the foundry superintendent that facing sand was an unknown quantity in the foundry. Naturally there was some fairly rough stuff turned out, but that did not trouble them. The manager expressed the view that the fetish for appearances in this country was carried too far. So long as they got the right texture of metal to ensure that when cast, or machined, or bored, or turned it answered its purpose they did not worry about the rough face. "Some of the castings they were turning out would have given some of you foundry foremen heart failure, I think," Mr. Kay added. In this case, too, they found labour-saving devices of every description and the last word in welfare. In the brass foundry the metal was melted in the electric furnace, which seemed to be in universal application in the United States. Mr. Kay enlarged on the wonders of Detroit from the motor-car manufacturing point of view, and in a reference to the Buick Works at Flint said that in the foundry mass production was in operation on slightly different lines from elsewhere, inasmuch as they did not use the conveyor system. He was unable to obtain any information as to how a jobbing moulder's wages were calculated. It seemed to be inferred that the jobbing moulder was there; he was a necessity and had to be paid, and his wage had not to be less than the man on productive work. As a consequence, the jobbing moulder had a very sound job. He worked very much on the lines of the jobbing moulder in this country with the exception that he was kept on productive work wherever possible, and received something like three times the wages. In the Buick foundry they had about ten moulders of this class, three of them Englishmen. Mr. Kay described as a replica of Dante's "Inferno" the place to which they descended in a lift where the castings just set and almost before they were cool were being sand-blasted. He could not conceive how men could work or even exist under such conditions. They were nearly all negroes or Mexicans, and wore a kind of gas mask, and they seemed to revel in the job. The foreman said they had a bath every night before they left. "And, by Gad, they would want it," was Mr. Kay's comment.

The Ford Concern.

Mr. Kay found himself nonplussed by the Ford Works. "I do not know how to start to describe it," he said, "it beggars description." When they got to the foundry he wondered whether they were in a foundry or not. It looked more like a

power house. There were 32 cupolas, and when he was there they were working three eight-hour shifts. Work never stopped, one squad succeeding another, and 2,400 tons of castings were turned out every 24 hours. The metal, of course, was conveyed round the shop in overhead travellers. Everything was moving except the worker, who did not leave his place. Though the soul-destroying monotony of some of the jobs had been recognised by Mr. Ford and an attempt had been made to mitigate it by a policy of change over every three months the experiment was not successful. The general foundry at the works was the finest he had ever been in. The cleanliness and tidiness of the place was astonishing. The cupolas and all the ladles, from a giant ladle which would hold anything from 20 to 25 tons down to the little ladle holding a few pounds, were treated daily with aluminium paint, the windows were cleaned daily, and there were 32 men in the general foundry to keep the place tidy. They employed something like 120 moulders in the general foundry, all the machine tools, electrical apparatus, locomotives, etc., that the firm required being made.

Machine Tool Making.

At the Crane Company's works at Chicago they again saw the rotary system of moulding in operation. Something like 1,500 tons of facing sand were used every day, and the sand was renewed weekly by night gangs and week-end gangs. Girl core makers were employed and were working under good conditions and receiving good wages. Nearly all the cores he saw were made to a jig, so that they were as fool-proof as possible, and the latest verifying devices were also installed. Mr. Kay next spoke about Cincinnati, remarking that some of the machine-tool foundries were an eye-opener. He could not conceive that machine tools could be produced under such conditions and in such quantities. How we in this country could compete with them at all was wonderful. In one huge place he did not see a single loose pattern moulder at work. They were making lathe beds and other accessories to machine tools by mass production.

Trade Unionism Unnecessary.

There was no doubt, Mr. Kay added, that enormous strides had been made in the United States as a result of co-operative methods. Their welfare schemes were on a grand scale. They had hospital and medical services and canteens for cheap and good food. They regarded lost time as a tragedy and took no risks. On the first signs of indisposition a man received attention. There were remarkably few apprentices, and when at the General Electric Company's works he inquired where they were going to obtain their moulders in the future. The reply was: "We can always get as many as we want from Great Britain." The class of labour in the States was very much inferior to that employed in British foundries, representatives of English-speaking races being in a hopeless minority in the foundries. In America the factor of psychology was not overlooked, and employers studied the man for the job. There was no doubt that there had been built up a splendid understanding between the employer and the workman. There were many things we could learn from the United States, though there were some that perhaps we did not want to learn. He did think we might adopt their methods of co-operation to a greater extent than was the case to-day. The men were doing exceedingly well in the United States, and in his opinion the time was rapidly drawing near when trade unions in the engineering industry in that country would be as dead as the dodo. Trade union officials assured them that conditions had reached such a standard that trade unionism had become unnecessary. Whether these conditions would last was another matter.

In conclusion, as showing the standard of life attained by a moulder who was trying to get on, Mr. Kay said that when at Pittsburgh he called upon a man working there as a moulder and whose address had been given to him. Calling totally unexpectedly, his first surprise was that a moulder was able to live in such a house. He rang the bell and the little negro waiting maid who answered it said her master was at dinner. Mr. Kay was given a hearty welcome and found the family circle attired in evening dress. The man was a working moulder and had been in Pittsburgh 23 years. He drove Mr. Kay back to his hotel in a 80 horse power car. "I do not say that that is the standard of every moulder in the United States," Mr. Kay concluded, "but I do say that it is a fair example of a man who is trying to get on."

Losses from Scrap.

Replying to a question as to what percentage of scrap was made where there was such huge production, Mr. Kay said that a casting was not scrapped in the United States if it was at all possible to make it do. In Cincinnati he saw lathe beds on the face of which there were huge scabs and which were nevertheless being machined, and he was assured that 95 per cent. of them were all right. Therefore he imagined that the percentage of scrap was not very high. As to working hours, they found that these were gradually being lessened, and at Schenectady the men had Saturday afternoon off. The splendid facilities provided for cleanliness were appreciated, and the men regarded them as part of their daily life.

Use of Gloves General.

MR. THOMAS TURNER, JUN., who said he had just returned from a three months' tour in Canada and the eastern States, said one thing that struck him was the use of gloves. Even the man sweeping up the shop seemed to wear protective gloves. The watchword was, "The product pays the wages," and he thought that we in England really needed to learn what that sentence meant. Time and again he was told that the men were not working piece work, but working in competition with this or that other department. They would see on a big notice board, "Output this week is so much, and last week so much." Another notice board would give particulars of accidents; they were working in competition to prevent accidents. Then they exhibited photographs of men who had long periods of service to their credit, and in addition to that recognition they received some monetary reward. Wherever possible unskilled labour was being used. They rather took a pride in that because they said it was the job of the works manager to make different pieces of work so simple that anybody could be put on it in a day or two. The workpeople were undoubtedly satisfied.

Answering other questions, MR. KAY said he did not think the American working man did half as much hard, laborious work as the workers in this country. He had everything to his hand.

Proposing a cordial vote of thanks to Mr. Kay, MR. D. WILKINSON expressed the opinion that when men were well paid and were not afflicted with the anxiety of paying their way, they could stand the monotony of repetition jobs. He was convinced that a great deal of the English fetish of a fine appearance might with advantage be got rid of. If we were to have a contented class of labour we must aim at producing things in such a manner as to yield a return enabling the manufacturer to satisfy every man's just desires and needs and to do justice all round.

MR. J. B. JOHNSON seconded the motion, which was supported by MR. W. J. FLAVELL and heartily accorded.

MR. KAY briefly acknowledged the vote of thanks.

AN INTERNATIONAL ENGINEERING CONGRESS is being planned to be held in Japan in the autumn of 1929.

MR. C. L. BAILLIEU AND MR. J. R. GOVETT have been elected directors of the National Smelting Company, Limited.

DIRECT STEEL PROCESSES.—At the meeting of the Association of German Ironmasters, to be held on the 27th and 28th inst., Prof. Dr. Wüst, of the Iron-Research Institute at Düsseldorf, is to read a Paper on the various direct processes for producing steel based on experience gained in the course of a personal visit in Great Britain, Sweden and Norway.

Wasters.*

By J. J. McClelland, M.I.Mech.E.

In collecting material for this Paper, the author has tried to divide the responsibility for wasters under two headings, one the moulder and the other the management, but this proved to entail difficulties and appeared undesirable.

The various types of wasters found in foundries reaches an almost astounding number. To mention a few would be to include "runouts," "short pours," "scabbing," "crushes," "blows," "cold shuts," "misruns," "cross joints," "cores lifting," "cores breaking," "contraction cracks," "strains and swells," "dirt and slag," "hard spots," "warping," "bad feeding," etc.

A kind of court of inquiry or inquest is helpful in all foundries, and the foreman or some equally qualified person should be appointed to call at least the apprentices together to discuss the cause of all wasters, and instructions should be given on how to prevent their repetition. As an apprentice the author made castings for mechanical stokers for boilers, and one of the castings came out badly scabbed. The foreman, after lecturing him soundly, kindly reminded him that if he noted the cause of the trouble he would have learned

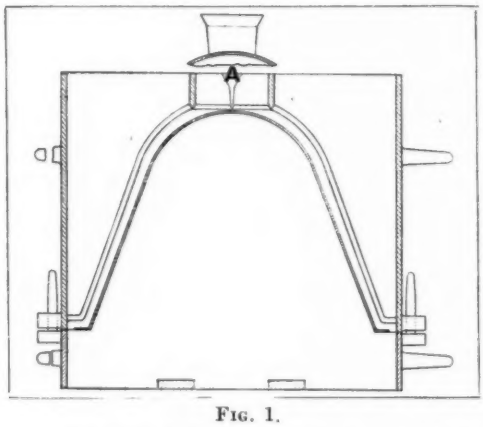


FIG. 1.

more from the bad casting than he would have learnt from a thousand good ones.

Runouts.

In Fig. 1—an ordinary scullery copper—it is quite obvious that if there be a runout there is little chance of saving the casting, and it is perhaps advisable to let it go and not waste further time and metal on it. Being thin, the casting will set quickly, which would add to the chances of being able to save it. The joint, being at the lowest extremity, adds still further to the possibility of its being saved.

To prevent this trouble, the joint should be rammed sufficiently hard. No joint can be rammed too hard, and when the mould is open nothing should be done to disturb or alter the shape of the joint. If this be done, and sufficient weights or cramps are used when casting, runouts will be considerably reduced.

Fig. 2 shows a lead pot, and in this case if there be a runout there is a better chance of saving the casting, but some moulders have a careless habit of leaning on their joints, sometimes slicking them over with their tools and sometimes kneeling on joints, all of which have a tendency to disturb the shape and create gaps through which the molten metal can find a way. If it is impossible to avoid getting on to a joint, then something should be spread over it to avoid damage.

Short Pours.

These are nearly always inexcusable. There are ample means of finding out how to calculate the weight of castings and the capacity of ladles, with which information it would be well for every foundryman to equip himself.

*Paper read before the Wales and Monmouth Branch of the I.B.F. at Newport, Mr. Galletly presiding.

Scabbing.

This is probably the most common evil in the foundry, and cannot always be attributed to faulty moulding. Materials provided by the management may sometimes cause a good deal of heart ache, and often a long time elapses before the true cause of the trouble is discovered. A personal experience might serve as a suitable illustration on this point. When visiting a certain foundry which was having considerable trouble from scabbing, the author was asked could he define the cause. He first inspected the sand, of which two kinds of sand were being used, namely, Mansfield and Southampton yellow, and upon examination it was found that the yellow sand contained large lumps of clear clay. The sands not being sufficiently well mixed, the clay lay in patches. When this trouble was eliminated scabbing ceased. Whilst clay is an essential in the foundry, it is an enemy when used indiscreetly.

Figs. 1 and 2 are almost similar in shape, yet very few moulders would recommend making these two castings in the same manner. Fig. 1, being thin, the casting has to be run very quickly, usually with a thin flat gate on top (A). If an attempt were made to cast the other way up, it would necessitate two or three runners on the joint of the mould, and even then success would not be

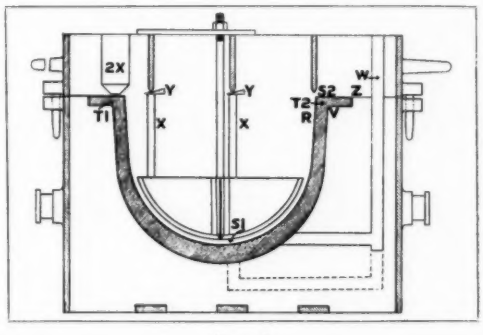


FIG. 2.

assured. Fig. 2, if made the same way, would probably scab because the gases could not escape sufficiently freely, and the casting, being so much thicker, contains more gases.

The internal portion of the sand is supported for lifting by the insertion of a four-winged grid or arbor. In the centre of the arbor is a screwed rod, suspended from a plate resting on two of the bars in the top portion, and to prevent the risk of screwing up too tightly distance pieces (X) are inserted, and a wedge (Y) driven in under the bar to ensure rigidity when lifting the top mould away for the withdrawal of a pattern.

In Fig. 3 is an outline drawing of a winding drum with double arms set at each end. It is cast in green sand, where the risks of scabs are great. To the general founder it is well understood that a job of this description contains nearly all the elements to which a moulder is opposed. In the first place, the moulder cannot be given a complete pattern to work with, the drum itself being 4 ft. × 3 ft., he will probably have to work from a pattern consisting of a plain ring, probably 9 or 10 in. deep, with loose arms and flanges for top and bottom. Consequently, he would only be able to ram initially to the depth of the pattern ring. Then the ring would need to be drawn up 3 or 4 in. at a time with additional ramming each time, and all this adding to the difficulties of making the job safe. As it is the general practice to make this class of work for casting on end, it will be obvious that the mould must be very firmly rammed all over, and particularly at the bottom end. It will also be apparent that special arrangements are necessary for getting the air or gases away from the outer portion of the mould, as well as from the core. Every precaution should

be taken to prevent the possibility of runouts at the bottom joints, for once the metal has started to make its escape in this vicinity there would be very little hope of saving the casting. Further, in connection with the core, it will be noticed from the illustration that the ordinary lifting plates as used for pulley arms are inserted, but for work of this description it is necessary that plates should be very securely attached to each other in the form of a stout bridge bar (M), or a similar arrangement for lifting the core when ramming is completed and for the extraction of the patterns. This being a six-armed drum, a lifting rod or eye bolt is shown at "N." There would be three such bolts distributed equally between the six arms. On the three remaining lifting plates it would be necessary to provide some means of preventing the pressure of the metal from lifting the plates. If these plates were allowed to lift, in consequence of the condensation which takes place in the mould they would be sweaty, and if the metal were to come into contact with this sweaty condition there

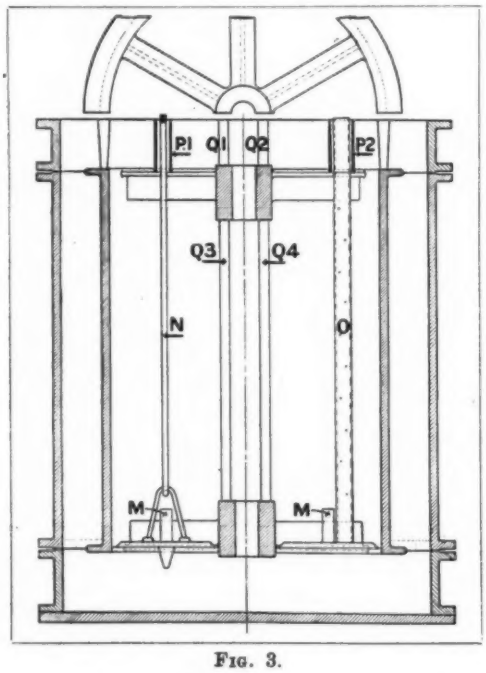


FIG. 3.

would undoubtedly be a very serious explosion, causing extensive damage and probably injury to those in the immediate vicinity. To provide against this contingency, on the three lifting plates where there are no eye bolts, an ordinary length of core barrel "O" is inserted which protrudes just through the top, and when the mould is completed these plates are fastened down by the most suitable means available. Six pieces of gas barrel, "P1 and P2," are rammed up in the top part around the eye bolts and core barrel to prevent damage when being removed and replaced.

The method of running found most satisfactory will be as shown at Q1, Q2, Q3 and Q4, representing two runners fixed on the top boss, which are extended through the core to the bottom boss. One peculiarity about this system of running is that the runners between the bosses must be comparative in size with the section of material in the casting. Otherwise there would be danger of unequal contraction in cooling, and if the runners had the tendency of cooling more quickly than the main casting they would be likely to cause fracture in the arms. It should also be borne in mind that they should not be made heavier than necessary, owing to the difficulty in removing them when the casting is being trimmed. In some cases, where they do not have the effect of being unsightly, they are not removed at all, but are allowed to remain in the casting where they undoubtedly would perform the function of a strengthening bar and distance piece between the two bosses.

There is one important feature in connection with a job of this kind and that is the necessity of careful venting and ample provision for the escape of gas, especially in connection with the core, as all gases must be brought away through the three-core barrels which also function for holding down the lifting plate. It is also necessary with a core of these dimensions and shape to insert a fair number of stiffening rods during the ramming up of the core and at least at two or three intervals there should be a good layer of small coke or cinders through which the air could escape rapidly to the channel of exit, which in this case would be the small pieces of core barrel. Great care is also necessary in ramming. The point of the rammer should not be allowed to come closer to the pattern than from 1¼ to 1½ inches. This practice applies to all classes of work in the foundry. If the rammer is allowed to come into close contact with the pattern, the result is a series of small shell scabs.

Crushes.

These are avoidable, and usually come from careless mending up or plastering on too much where it has been found necessary to patch a mould. To be on the safe side, every mould should be re-opened after closing, to ensure there is no trouble of this character. Blows also have several causes. They are chiefly attributable to gases in the metal. The moulder is not responsible for the materials used in metals, consequently he is not always responsible for blowholes. As is well known, cast iron naturally absorbs sulphur, and if a faulty supply of coke is obtained which contains more sulphur than it should, the iron will absorb some of the sulphur which might probably show up later in the casting in the form of blow holes. The moulder is sometimes at fault with his ramming, or if he uses sand containing too much moisture, also improper venting, or the placing of runners and risers in the wrong position.

Cold Shuts.

Here the moulder can be responsible, and perhaps, also, the management, should the latter insist upon the use of metals unsuitable for the work in hand. For instance, Fig. 1 could not be cast with strong Scotch iron, and even in Scotland, where a large amount of work of this type is made, Middlesbrough iron is chiefly used, owing to its excellent fluidity allowing free running for thin castings. It is also not so troublesome from a contraction point of view. For Fig. 2 and Fig. 3 the lower phosphorus irons are more suitable. In the case of thin work, if the sand be too strong, it would have the tendency of hindering the free flow of metal, resulting in cold shuts.

Cross Joints.

These are also inexcusable. Faults of this description may be attributable to both sides. Where boxes are made to fit too loosely, there is a well-known practice of keeping them twisted in the direction of the travel of the sun, and if this is not possible, there are other methods for making sure that the joints meet properly. On the other hand, it is far better, and it removes the possibility of risks being taken, if the management will provide well-made boxes for use in the foundry, and thereby eliminate this class of trouble to a large extent.

Cores Lifting.

The moulder often has complaint against the pattern-maker on account of insufficient prints so often being put on patterns. Take an 18-inch cylinder, for example, probably from two to three feet long. A common practice would be for the pattern-maker to only put on an inch or an inch and a half core print on the pattern, leaving the moulder the difficulty of having to secure a core on prints of such dimensions. This is a system of false economy, and although it may mean the saving of a few pence in the pattern-shop, it necessitates additional work for the moulder, besides the added risk of losing a casting. The American practice is to go to the other extreme by providing ample core prints on all types of cylindrical or pipe patterns. They do not use core barrels as numerously as we do. Chaplets also prevent cores from lifting and the proper use of these accessories should be well understood.

Cores Preaking.

This may be more attributable to the core maker than to the moulder. Every core should be satisfactorily ironed and strengthened, and of course a good core cannot be made with bad sand.

Contraction Cracks and Warping.

These cannot always be attributed to the moulder, yet he should be conversant with the causes and remedies. By giving proper attention, some castings can be prevented from warping. Take a lathe bed for example. Such are not designed of equal proportions, and therefore part of the metal has completed contraction before the remainder. This means that the box portion of the bed, which is designed to be of sufficient strength to bear the anticipated load, is always thinner in section than the slide rails, which have to take the wear and tear of the saddle. A common practice when moulding this type of casting is to bend the pattern to the same amount as the anticipated warping. This is not the most desirable method, as a casting treated in this way always retains a strain on the structure, which is never released until fracture takes place. The more preferable custom is to mould the pattern straight, and immediately after casting, when the iron has solidified, the heavier sections should be stripped and made bare, in accordance with the dimensions of the bed being made, so that the heavier sections may be encouraged to cool down and complete contraction in the same period of time as the lighter section. This produces a casting free from strain, and is much more satisfactory to all concerned.

Strains and Swells.

These are usually the result of careless and unintelligent ramming and are nearly always avoidable.

Dirt and Slag.

These complaints very often arise from the unsatisfactory system of arranging runners. Fig. 2 illustrates a runner "W" carried to the base of the casting. It would be possible to run the same casting on the joint at "Z," but the results would more than likely be unsatisfactory. Firstly, there would always be a suction in the runner during the casting, which would naturally attract all dirt which got into the pouring bush, conveying it into the casting. Secondly, the flow of the metal over "V" would have a tendency to cause scabbing, and beating against "R" may also create the same trouble and the dirt which would accumulate from these two troubles might become apparent at points "S1 and S2." In all work of this description, it will undoubtedly be found preferable to carry the runner to the bottom if possible.

In the same illustration we get an example of the effects of sponginess and faulty feeding. Although the bottom of the pot is of a thicker substance than the sides or the flange, it is not usual to find sponginess in the bottom portion of the casting. It would be more likely to appear at "T1" and "T2." This could be overcome by the introduction of a riser at "2X." This would act as the feeder, and it will be noticed that a riser has been made considerably larger in sectional area than the casting, the idea being that this is always preferable where possible. It is recommended that in casting a job of this description, pouring should cease immediately the metal has appeared in the riser. Probably a handful of charcoal would be helpful in retaining the temperature until it would be possible to bring along a fresh supply of hot metal from the cupola, with which the riser should be filled to the top. With the renewed rising temperature the riser would have a tendency to remain fluid until the main casting had completely solidified. If or when it is found necessary to resort to the use of a feeding rod, the operator should be very intelligently schooled in the use of same.

Discussion.

In opening the discussion, MR. GALLETLY (President) suggested that an improvement might be effected in the system of running Fig. 2 if the method shown by dotted lines were used in place of the runner shown. This point was agreed, but it was suggested the introduction of such a runner might entail some difficulty. Mr. Galletly also confirmed the types of iron necessary for light and heavy castings, stating he had had an unpleasant experience owing to high-phosphorus iron having been used for a heavy casting.

MR. HIRD, referring to the question of clay in the sand, stated that there was clay in all moulding sand, and if it was eliminated, the sand would be useless for moulding. It was interesting to examine washed and raw sand under a microscope. The former appeared as a bright substance, whilst the latter had a little coating of clay covering it.

He asked for an expression of opinion on open and closed risers, the reply being that closed or covered risers should be used, particularly in connection with thin work, where it was necessary to rush the metal in as quickly as possible, which usually causes risers to roar, which in turn has a tendency to pull down the faces of the mould. MR. HIRD thought that for some classes of thin work there was an advantage in having an open riser. If it were closed there was pressure on the sand all the time. With regard to coal dust, he asked whether it was advisable to use none at all or a reduced amount for thin work, or should old sand be used.

In reply, MR. MCCLELLAND said that for very thin work no coal dust at all was required. By way of illustration he quoted that when making thin, flat plates about 5 ft. by 3 ft., ¼ in. thick, with a 1-in. flange all round, it had been found that an equal proportion of new and old sand thoroughly mixed and a coating of plumbago on the face of the mould had been most satisfactory. Fig. 1, for example, would always be made without the use of coal dust.

Replying further to Mr. Hird, the speaker said that the elimination of coal dust helped to prevent seams on thin castings. For varying types of castings it was suggested that coal dust in the proportion of 6 to 1 should be used for heavy castings, 8 to 1 for light castings, and for very light castings no coal dust at all. For a casting as illustrated by Fig. 2, the proportion should be 6 to 1.

MR. HIRD thought it was very difficult to get a lathe bed straight by stripping, but thought that by putting in cambers, although admitting there always was a strain, this was not a serious defect.

MR. MCCLELLAND replied that whilst it might be all right to camber the pattern of a small lathe bed, he could not agree with the practice when making a large lathe bed, say, of 11 tons. Weighting moulds had been referred to in connection with runouts. The rough practice in many foundries was to use three times the estimated weight of the casting. A well-known moulding machine maker in America had advocated that there was a 3½-lb. to the sq. in. lifting pressure on all types of castings, no matter what their depth, but the more reliable formulæ was one established in this country of 1-lb. pressure to the sq. in. for every 4 in. of depth, *e.g.*, 8 in. deep would have 2 lbs. pressure to the sq. in. and 12 in. deep 3 lbs. pressure per sq. in., and so on.

MR. JENKINS spoke of having seen a pot very similar to Fig. 2 made the reverse way, with disastrous results, the casting having a perforation in its base when the test was made with water.

MR. EVAN DAVIES asked what method would be adopted in extracting the pattern from the mould in Fig. 3. Also, whether it would help matters if the runners were put in on the slant to prevent contraction between the bosses. The reply was that it would be necessary to lift the middle part of the mould away and then withdraw the core to extract the pattern and make the necessary repair to mould; also for convenience of blacking same. With regard to the slanting runner, this method might be an improvement on that shown.

MR. KINSMAN asked whether the runner in Fig. 3 was not liable to cool more quickly than the other part of the casting, the reply being that the runners should be of such proportion as to obviate this. At the same time, it must be remembered that by the flow of molten metal through the runners whilst the casting is being poured, the surrounding sand is raised in temperature to such an extent that it assists in retaining the heat in the runners so that the whole casting cools down more or less equally.

MR. R. G. WILLIAMS stated that patternmakers did not like to take any blame, but preferred to refer to draughtsmen's errors and patternmakers' oversight. It was part of their duty to consider the economical use of their materials.

In proposing a vote of thanks to the lecturer, MR. P. LEONARD GOULD offered congratulations, saying that he thought this was the type of lecture needed in this Branch. MR. MARSH seconded, and the motion was supported by MR. R. G. WILLIAMS.

The International Foundrymen's Convention at Detroit.

The Tour of Overseas Foundrymen under the Auspices of the American Foundrymen's Association.

(*Continued from page* 468.)

By Our Special Correspondent.

Niagara the Impressive.

There being no "morning after the night before" in this land of water, pure and undefiled, we were up with the lark next day, and soon comfortably ensconced in motor buses provided by Thos. Cook & Sons for the trip to Niagara Falls. The wide, level streets of Buffalo were quiet and empty on that Sunday morning as we wended our way past the stately homes of its well-to-do citizens, each with its green plot, its shrubs and its gorgeous flower beds, parted from the pavement by neither hedge nor wall.

The great heat had passed; the morning was fresh and bracing, and soon the buses were by the side of the river, sparkling in the morning sun. Here a magnificent vista was spread before the travellers' eyes. On the left the broad Niagara River, widening westward to the inland sea of Lake Erie, and on the right a huge bridge under construction, but incomplete save for one pier or segment. This bridge is being built in commemoration of the signing of peace after the Great War. It is known as "Peace Bridge," and we understood it to be paid for jointly by Canada and the United States. It should be explained for the benefit of those who have (as the writer had) forgotten the geography of their schooldays, that Lake Erie at its Eastern end turns north, narrows down, and becomes the Niagara River, which hurls itself over Niagara Falls, spins in a whirlpool, plunges through a gorge, widens out into a pool, and then pours itself into Lake Ontario.

Back in the British Empire.

In this district this chain of waters separates Canada from the United States, and there being no bridge at that moment (or at that point) the buses had to wait in their turns for the arrival of a ferry boat, on whose broad deck they presently rested, to be soon duly landed in the British Empire. There were no Customs formalities, either on leaving the shore of the United States or on landing in Canada, though possibly the Tourist Agency had given some kind of an undertaking or guarantee in advance, or the wanderers were passed through unquestioned because of the respectability of their appearance.

Was it imagination, or did one, immediately on landing in Canada, begin to notice small details in which it differed from the United States? Was there a more homelike touch, less sacrifice of the beautiful to the useful, and a more English type of architecture?

The road wound by the side of the river for several miles, through fields purple with Michaelmas daisies, and gay with white and yellow butterflies, and great flying black grasshoppers, the United States plainly visible across the water in an ever-changing panorama of beauty or interest.

Wrecked Bootleggers.

By degrees the river began to hurry more and more rapidly towards the Falls. Boats in which stout men fished peacefully, but, methought, with little hope, ceased to be seen. The river became a tearing, rushing torrent, at length a sea of foaming, troubled, tossing waters, surging violently over sunken rocks on which lay the desolate wrecks of bootleggers' crafts who had, with poetic justice, lost in water what they made in whisky!

Then a smooth, swift, headlong rush of black glassy water over the precipitous cliff of the Falls, and down, in a spume of mingled foam and spray which hides the very sun, and a thunder of roaring waters which fill the air with sound, to spin in the whirlpool far below.

Stupendous as is Niagara, and impressive as is the sight, the river falls into an abyss so deep and with sides so high that an observer on the road far above feels little of the mist, and is certainly not deafened by the noise, mythical traditions of "The Thunder of the Falls" being heard for miles notwithstanding.

Striking beyond words as is the general spectacle, its size and majesty can only properly be realised by those who take the downward path, pass between the cliff and the water of the Falls, and, clad in black or yellow oilskins, thread their way in single file from rock to rock, the water roaring first overhead, then underfoot. Most of the party made the descent to the caves of the winds and the waters, and none to-day regret this thrilling experience.

A Giant Power Station.

After inspection of a stupenduous turbine plant generating electricity by means of a stream of water conducted through the fields from the river, well above the Falls, an excellent luncheon was served at the Fox Head Inn. This charming hostelry of inviting appearance is built in the Tudor style, and not unlike certain old English roadside taverns, is famous for its beer; for Canada permits her sons a stronger brew than does Uncle Sam.

The "Fox Head" is an inn with an ideal, and it greets the traveller with Shenstone's famous lines:—

> "Whoe'er has travell'd life's dull round,
> Wher'er his stages may have been,
> May sigh to think he still has found
> The warmest welcome at an Inn."

Space forbids a fuller description of the beauties of Niagara, but an idea of the general lay-out may be given. The Falls, themselves, are at the southern end of the village, and beyond them, towards the south, are few buildings except power houses, which, by the way, are well built and ornate, and, on the Canadian side, do little to mar the beauty of their surroundings. On the American side are many disfigurements due to industrial enterprises which use the electricity.

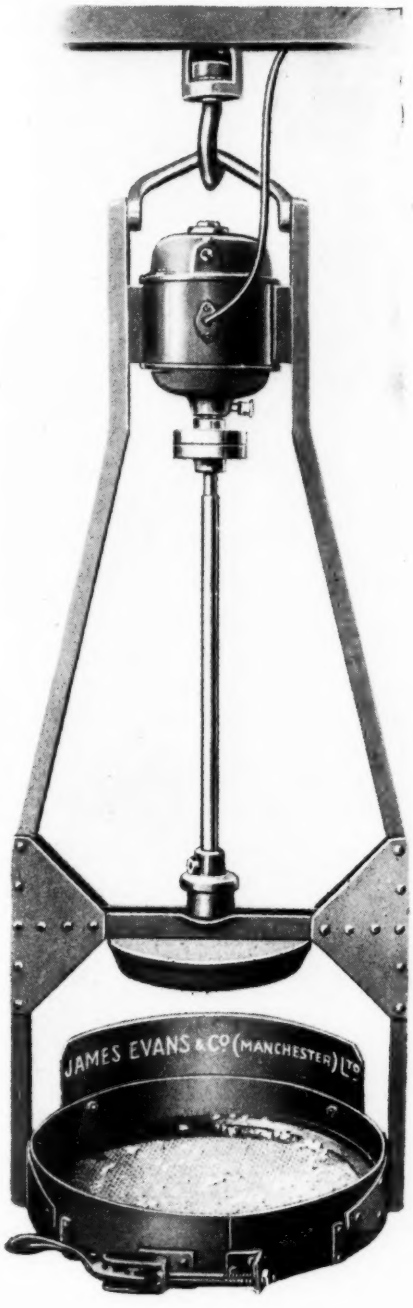
"The Maid of the Mist."

Coming north from the Falls, a footpath with a balustrade skirts the deep, steep sides of the whirlpool, in which cruises the celebrated little pleasure steamer "The Maid of the Mist." Alongside the path are green lawns, with flowers, shrubs and trees, grottoes and little resting places, with seats whereon the visitor may muse o'er Nature's wonders, and then behind the broad road, thronged and lined with motor cars and buses.

Across the road more velvet lawns of the true old English quality, and behind them, charmingly picturesque in their architecture, hotels, buildings and residences, often covered with creepers, and hidden here and there by groves of trees.

Pursuing the road northwards, there are then found shops and sundry other buildings, first on the left and then on the right also, with the whirlpool spinning and screaming far below them. Next on the right a girder bridge which spans the rushing torrent, and joins Canada to the States, and after that the magnificent river boulevard, the

EVANS'S ELECTRIC
GYRATORY FOUNDRY RIDDLE



THE saving accomplished by the use of our Electric Gyratory Riddle pays for the cost of the machine in a few weeks' time.

It will sift more sand with one operator than six men sifting by hand. In addition to this it mixes the sand better, and produces a better grade than hand labour.

The machine is portable and may be moved to any place in a few moments (where a hook for suspension is available and electric current in service) and set in motion instantly.

Motor and working parts are all above the sieve, thus preventing the sand from interfering with the operation of the machine.

Power required, ¼ B.H.P.

JAMES EVANS & CO. (M/c) Ltd.

BRITANNIA WORKS,

BLACKFRIARS, MANCHESTER.

whole affording a twenty-mile drive of wonderful scenery along the Canadian shore.

A Perilous Descent.

Now the river narrows for its final burst through the gorge to Lake Ontario and freedom. Nerving the ladies to the ordeal and bidding them close their eyes, we took our seats in little open cars resting perilously on a steeply sloping cable tramway. After the descent we dismounted in good order with morale unimpaired and faced the angry stream, which, chafing at the narrows through which vast cliffs on either side compel its passage, goes tearing, roaring, threshing, leaping, northward to the sea in a tumbled, turbulent, tormented mass of ever-changing, humping, cliffs of vicious black water, foam fringed, whose green abysses affright the very eye of the onlooker, a boiling witches' cauldron of a river gone mad.

A Bold Englishman.

We were told that this was the torrent that bold Captain Webb essayed to swim across, and at this spot he lost his life. Nothing but a miracle could have saved it, for no Atlantic sea was ever so rough or less inviting for a morning swim.

The cliffs consist of varying strata of limestones, sandstones, and shales, apparently of Jurassic age, and the Falls themselves seem to be due to a great Fault in the rocks. Rock crystal, malachite and ironstone also occur, and it was noted that the shops offer necklaces made from the former.

With the angry stream roaring at our feet, we followed a path far enough to reach a hut nearly carved away with the initials of visitors, who now, for want of space, pin their cards to its walls, then retracing our steps, and noting the wild black grapes which grew in clusters at the foot of the cliff, we ascended the tramway and rejoined our vehicles, waiting on the roadway above.

Across the Torrent on a Rope.

The next and last marvel shown to us was the aerial ropeway over the wide pool into which the waters from the Gorge emerge. So far below the road are these whirling, swirling waters, just freed in angry confusion from their headlong rush through the Gorge, that the 20-ft. fir poles which spin around in them for ever and ever seem no bigger than match stalks. A frail basket of steel conveys the intrepid to the United States over wire ropes, but so awful is the height and so forbidding the view of the hungry waters below that only the very boldest find any joy in looking down at them.

The Acheson Graphite Works.

Sternly turning our backs on delightful prospects which lured us further northward, we remounted our vehicles and set our faces southward, then over the bridge where U.S.A. Customs officials lying in wait for "bootleggers" were easily satisfied by the engaging candour of the foundrymen and the badges they wore.

The city of Niagara Falls, U.S.A., lies immediately over the bridge, and our road led us past the vast Acheson graphite works, the home of electrodes, a huge place which bordered the road on either side for quite a long distance. We passed many power stations, seeing on the right how the Niagara River divides into two streams, one of which produces the straight-fronted American Falls, and the other the curved or horseshoe Canadian Falls, divided by a central island which is U.S.A. territory and reached by a bridge.

Many factories which need large supplies of cheap electricity are to be seen at Niagara Falls, but we had an appointment with a ship at Buffalo, and so, through turns and twists, we came once more to the placid water, where was waiting for us, with all our luggage safely on board, the magnificent lake steamer, "Greater Buffalo," a splendid steamer, polished, carpeted and equipped equal to any Atlantic liner.

A Fight for Food.

Experience after experience crowded upon the travellers, and it is not well to dwell upon their fight for food on board at dinner time. Though the catering was ostensibly in charge of a gentleman bearing a Scottish name, and presumably therefore of Scottish origin, the dining-room was the arena in which food seldom appeared and never remained. Monosyllabic gentlemen of colour occasionally appeared with something in the nature of provender for the starving band who watched their every movement with hungry eyes, but suffice it to say that we had never seen worse service at any meal we had ever hoped to consume; we had never before experienced a wait of half an hour between one course and another, and we had never known 2 hours and 10 minutes to be occupied by a dinner when not more than 20 minutes were occupied in eating. We actually got some of the courses out of their proper order, but, we reflected, we came here to see and to learn, and we saw and we learnt.

However, everything comes to an end, "And so," as Pepys said, "to bed."

How different from the ever-present roar of an Atlantic passage was the smooth travelling on the placid Lake Erie, through the still blackness of the night. Lights glimmered fitfully on the southern shores, and the occasional cry of a bird was heard, but the rest was silence, except for the throb of the screw.

Engines in a Glass Case.

The engines in this boat were an engaging feature. They were as spick and span as a housewife's copper kettle, and as evidently the pride of their custodians. By someone's happy thought, they were continuously visible to the passengers by reason of their being at the foot of a glass well which penetrated the decks of the steamer, and through the transparent walls of which they could be seen at all times smoothly revolving in unhurried efficiency.

We were glad enough to rise betimes in a grey lake mist in the morning, for the best of steamer bunks are not quite as seductive as a bed.

We saw the lake narrowing and shallowing until both coasts became visible, and buoys marked our path, until at 9 a.m. we arrived at Detroit to receive an enthusiastically glad welcome from Mr. J. Kent Smith and his charming daughter, who were waiting on the quay highly delighted to meet old friends.

Amongst important members of the Detroit Reception Committee waiting to receive us it is impossible to forbear from according special mention to Mr. Stuart W. Uttley, a Past-President of the Employers' Association of Detroit. Mr. Uttley is associated with the Detroit Steel Casting Company, and he was kindness and helpfulness personified.

A Hearty Reception at Detroit.

When all without exception and in their varying ways and manners held out such welcoming hands and proferred such courteous hospitality, it is hard to particularise, but Mr. Uttley is now President of the American Foundrymen's Association itself, and was ably helped by fellow Detroiters in Mr. Robert Crawford (who still speaks with a Scotch accent), Messrs. Russell M. Scott, and the members of the Reception Committee, which consisted of Messrs. Culver, Tout, Carolin, Kirby, Pike, Rypsam, Thomas, Lenz and Grant.

Far be it from your correspondent's mind to give the impression in mentioning these names that there were not literally dozens of other friends who performed a like service and in a like manner. The mind of man is but finite, and with due apologies to all the others, he can only recollect a portion of the names, though he, along with his fellow sojourners, can never forget the kindness received on every hand.

"Uncle Billy" from England.

Mr. A. V. Root, the retiring President of the A.F.A., was there, and so were many others whose names have been previously mentioned, but we should fail in our duty to mankind if we omitted reference to "Uncle Billy," by which name he is known through the length and breadth of American foundry interests, Mr. William Chambers, of the Material Service Corporation, of Chicago, one who goes up and down the land

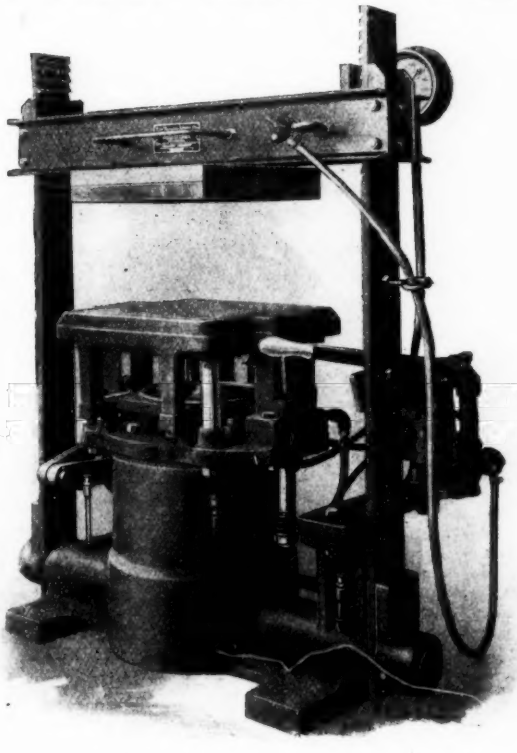
MACNAB & CO.

TABOR MOULDING MACHINES

FOR EVERY CLASS OF WORK.

Accurate Definite Draw with Permanent Accurate Alignment.

All Operations Controlled by One Lever.



Uniformity in size of Castings produced.

All Moulds squeezed alike to whatever Pressure Required.

Minimum Percentage of Wasters.

The above illustrates the TABOR POWER SQUEEZING "SPLIT PATTERN" MOULDING MACHINE, specially suitable for all small patterns which can be split in halves or for flat back work.

A customer writes:

"The Machines draw perfectly in producing deep castings with the minimum amount of taper, and we are fully satisfied with them, as they are most economical in use and give the maximum production."

For brass castings demanding precise accuracy, a well-known manufacturing firm makes 760 half moulds in 6½ hours with one man on the above machine, using boxes 13″ by 18″, cope 4½″, drag 4½″. Some of their machines have been in use 16 years, and the newest is 6 years old. How's that for production and low cost!

Capacities and Dimensions furnished upon application:

56/8, Eagle Street, Southampton Row, London, W.C.1.

Works: TOTTENHAM, LONDON, N.17.

with firebricks, fireclay and foundry sands, but has not yet forgotten Sheffield, where he was born, nor his distant relationship with the late Mr. Jethro Chambers (of Chambers Bros., Limited). Uncle Billy has seen 84 summers and goodness knows how many winters, but none of them have chilled the warmth of his spirits, the beaming friendliness of his smile, nor his faith in human nature, and in the future of the foundry industry. Uncle Billy, whose photo. we reproduce, was a journeyman foundryman, employed at Browns, in Sheffield. He came to the United States long years ago, and claims to be the very first man to make a steel casting in America. It is astounding that this industry should have grown to its present stupendous dimensions during less than the lifetime of one man, and British foundrymen were very glad to shake hands with their pioneer compatriot.

Detroit: a Wonderful City.

Detroit is a city of charm and interest. It was founded by the French, who were very busy in North America about then (hence its name, which is pronounced, by the way, *Dee*-troit, and not, as is usual in England, De-*troit*).

It was in 1701 that Cadillac, the father of Detroit, landed on the site of the present city, and in the following year arrived his wife, who was the very first woman to come to the city-to-be. Unfortunately for Cadillac, the French Colonial system was rotten with intrigue and scheming, so that Cadillac's authority was soon undermined, and instead of being in charge of the entire adventure in that district, he was finally made a commander of the garrison only. Later he was removed entirely, but the post which his vision had been instrumental in founding passed through many vicissitudes under successive French Governors, until the end of the war between the French and the Indians, when, in 1760, Major Robert Rodgers took possession of Detroit in the name of the British.

British and American Enterprise.

At the end of the Revolutionary war Detroit was handed over to the United States Government, possession being given in 1796. The French had tried to live, it is said, as far as possible at peace with the Indians, carrying on only the fur trade and some small exploitation of the country through the Indians. The British had an entirely different idea, and wished to sweep the Indians aside, take possession of the country for the white men, and develop its resources to the utmost extent themselves. This same idea was followed by the United States when they took possession.

Detroit remained essentially a frontier trading post, with a constantly growing surrounding farming community, until the development of the great white pine industry throughout the States, when it commenced to shoot ahead, and has never ceased to grow since.

The Stove Trade in Detroit.

The first industry of interest to foundrymen to be commenced in Detroit was the stove trade. A number of stove companies came out from the New York district and established four great foundries here. These have now been reduced to two companies by consolidation and elimination.

Much could be said of the development of other lines of manufacture in Detroit, but it is sufficient to state that it was once a great producer of carriages, buggies and wagons, and naturally turned to the automobile as it developed, until to-day Greater Detroit is known everywhere as the world's principal motor-car manufacturing centre.

(To be continued.)

THE American Foundry Equipment Association reported to a meeting held in conjunction with the American Foundry Supplies Association that an advance of 17 per cent. had been made in sales over the corresponding period for last year.

Atomised Coal.

Considerable research has recently been carried out on the use of what is known as "atomised" coal, especially for use in the melting of non-ferrous metals. This atomised coal only differs from pulverised coal in fineness, atomised coal being ground to pass a 200-mesh screen. The difference between atomised and pulverised coal does not appear to be very great at first sight, but the finer fuel is stated to have a great influence on combustion. In preparation the coal is first of all crushed to about the size of grains of wheat, after which it is dried. The coal is then atomised in a rod mill, in which it is kept in a state of agitation by a blast of air, and the fuel is finally reduced to the consistency of flour and bagged in strong paper bags. The atomised coal is fed into the furnace by means of an automatic measuring device, which regulates the passage of the fuel to a fan, which blows it into the furnace. The combustion space in these special furnaces is made smaller than usual, and the coal-laden air is blown into the furnace at a pressure of 3 oz. to the inch, *i.e.*, just sufficient to carry it in. This pressure ensures that there is no excess of oxygen, so that the atmosphere in the furnace is of a steadily reducing nature. The furnace is of the standard crucible type lined with a refractory material. The furnace heats quickly and produces a good metal. The process has not yet been commercialised, so that the proportion of fixed and overhead charges are relatively high, though in normal times it is estimated that the cost of the fuel, including atomising and bagging, will work out at slightly over £1 per ton. The cost of the plant is small, but the total cost of the fuel as delivered, including capital, interest, depreciation, administration, sales and shipping, raises the figure to about £2 15s. per ton on the basis of small production. Were the process to be commercialised, of course, the final cost would be appreciably reduced.

Company Notes and News.

Electrodes, Limited.—Capital £500 in £1 shares. Directors: J. L. Graham, The Stud, Carlton-on-Trent, Notts; and N. Phillips, 29, Station Road, Sutton-on-Trent, Notts.

E. O. French, Limited, 44, Earl Street, Coventry.—Capital £10,000. Metal manufacturers.

W. & J. F. Jones, Limited, Foundry Road, off Bolton Road, Pendlebury, Lancs.—Ironfounders. Capital £4,000 in £1 shares. Directors: W. Jones and R. A. J. Jones.

John Meller & Company, Limited.—Capital £100. Engineers, coppersmiths and brassfounders, carried on at Commercial Street, Knott Mill, Manchester, by representatives of late W. G. Lecomber as John Meller & Company.

Thos. Ryder & Company (Manchester), Limited.—Capital £20,000 in £1 shares. To acquire business of engineers, coppersmiths, and brassfounders carried on at Commercial Street, Knott Mill, Manchester, by representatives of the late W. G. Lecomber as Thos. Ryder & Company.

Richard Spencer, Limited, 136, Rice Lane, Liverpool.—Capital £4,000 in £1 shares, to acquire business of an ironfounder and engineer carried on at 136, Rice Lane, and 1/11, Salisbury Road, Liverpool, by Elizabeth Spencer, as Richard Spencer. Mrs. E. Spencer, permanent governing director.

The United Kingdom Ferro-Manganese Company, Limited, 305, Winchester House, Old Broad Street, E.C.—Capital £350,000 in £1 shares (300,000 6 per cent. cumulative preference and 50,000 ordinary). In a winding-up the preference shares rank in priority to other shares for return of capital and arrears of dividend. To enter into agreements (a) with Central Provinces Manganese Ore Company, Limited, and (b) with Darwen & Mostyn Iron Company, Limited, Dorman Long & Company, Limited, United Steel Companies, Limited, and Wigan Coal and Iron Company, Limited. Directors: M. Wilkinson and H. R. Holmes (nominated by C.P.M.O. Company) and W. Thomlinson and E. Beck (nominated by Ferro-Makers). Secretary, L. L. Benke, Firthwood Avenue, Northwood.

Leeds Fireclay Company, Limited.—Profit, £39,411; realisation of investment in freehold property, £17,709; brought forward, £15,743; dividend, 5½ per cent. on ordinary shares; dividend equalisation account, £20,000; reserve, £17,709; carried forward, £7,155.

Merry & Cuninghame, Ltd.—Dividend on 7 per cent. cumulative preference shares for half-year ending November 30 passed.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

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LADLES,
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PIPE NAILS,
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Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS, FIRE CLAY.

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STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Trade Talk.

TUBE INVESTMENTS, LIMITED, have acquired the tube business of the Midland Tube and Forging Company, shares in the former concern being issued in payment.

CAMMELL, LAIRD & COMPANY, LIMITED, of Birkenhead, have received an order from the Lancashire Shipping Company for two vessels of 9,000 tons deadweight, fitted with Diesel engines.

MESSRS. J. W. ALDAM AND J. KELLINGTON, engineers, ironfounders and hardware merchants at Misterton, Notts, trading under the style of Aldam & Company, have dissolved partnership. J. W. Aldam will continue the business.

LORD GLANELY has placed orders for two new steamers of 9,000 tons each with Robert Thompson & Sons, Limited, of Sunderland, and for one steamer of 9,000 tons with William Pickersgill & Sons, Limited, also of Sunderland.

THE TENDER of W. McLellan, of Dunedin, which is in the neighbourhood of £200,000, has been accepted for the remodelling of the New Zealand Government railway workshops. Sir William Arrol & Company, Limited, will supply the steel-work.

THE UPPER SILESIAN UNITED IRON-WORKS HUTA KROLEWSKA & LAURA, MINING & IRON-WORKS CORPORATION, of Katowice, have taken over the works and mines in Poland belonging to the Vereinigte Königs u. Laurahütte, Aktiengesellschaft für Bergbau u. Hüttenbetrieb, of Berlin.

THE FAIRFIELD SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Govan, have despatched by road a Ruths steam accumulator, which they have constructed for the service at Grangemouth of Scottish Dyes, Limited. The accumulator is 44 ft. in length and 13 ft. in diameter.

SIR GORDON LEY, governing director of Ley's Malleable Castings Company, Limited, Derby, has announced to the employees that in spite of the difficulties arising through industrial depression, £7,500 will be transferred by the company to the Profit Sharing Fund of the workmen. This means that each one of the 1,100 employees will receive a little more than a fortnight's wages as bonus.

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION, LIMITED, have appointed Capt. E. Vernon Hine as their resident engineer for the Sheffield area. Capt. Hine, who has been in charge of the company's Middlesbrough office for the past seven years, is extending his activities to the Sheffield district, and this territory will thus in future be under the direct charge of one of the company's staff instead of being served by the agency which has existed heretofore.

SPENCER (MELKSHAM), LIMITED, have received the order for the complete equipment of the new post office now being built by the Union of South Africa at Cape Town, which consists of conveying machinery for the expeditious handling of mailbags, parcels, etc., and is on similar lines to the extensive plants now being constructed by the same company for His Majesty's post offices at home. They also have instructions from the Buenos Aires Great Southern Railway Company to supply the whole of the dust extracting plants for the four terminal grain elevators at Bahia Blanca, which were fabricated and equipped by the Melksham firm some years ago. In addition to the contract for the grain-handling plant for the new grain warehouse now being built by the Leith Harbour Commissioners, Spencer (Melksham), Limited, have also the order for two pneumatic travelling elevators for discharging steamers, together with the steel gantry work, and conveying plant, to feed the new warehouse.

Contracts Open.

Cape Town, December 15.—Cast-iron pipes, specials, valves, water-meters, etc., for the Goodwood Village Management Board. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. A.X. 3,855.)

Durham, December 15.—(a) Cast-iron pipes, from 2-in. to 6-in. diameter, during the six months ending June 30, 1927; (b) special small castings during the twelve months ending December 31, 1927, for the Durham County Water Board. Mr. W. R. Ward, clerk, 25, Northgate, Darlington.

Margate, December 6.—168 yards of 6-in. main and 594 yards of 4-in. main, together with the necessary hydrants and fittings, for the Corporation. The Borough Engineer and Surveyor, 13, Grosvenor Place, Margate.

Middlesbrough, December 4.—Castings, bolts and nuts, for six or twelve months, at the option of the Tees Commissioners, from January 1, 1927. Mr. J. H. Amos, general manager, Head Office, The Tees Commissioners, Middlesbrough.

Obituary.

THE RIGHT HON. FREDERICK LEVERTON HARRIS, whose death is announced, was originally a director of Harris & Dixon, Limited, 81, Gracechurch Street, E.C.3.

MR. R. M. CAMPBELL, late of Leeds and Harrogate, has died at Sidcup, Kent. Mr. Campbell, who was fifty years of age, had been in ill-health for the last four or five years. A son of the late Mr. James Campbell, of the Hunslet Engine Company, Limited, he was a director of the concern.

MR. L. JACOB, whose death has occurred at Shanklin, Isle of Wight, following an operation, formerly resided at Olton, Birmingham. He was for many years managing director of Henry Pooley & Son, Limited, and when that company became associated with W. & T. Avery, Limited, in 1914, he joined the board of the latter company. Mr. Jacob was seventy years of age.

MR. T. DOWNIE, ironfounder, died at his residence, Norwood, Falkirk, on November 17. He was for many years prominently identified with the light castings industry. He was director of Grahamston Iron Company, Limited, Falkirk, with which firm he started his business career in 1876. Since 1914, when the company was incorporated as a private limited company, he had acted as its chairman.

MR. ALFRED SLATER, whose death has taken place at Cheltenham, was for many years prominently associated with the commercial life of Gloucester. The son of the late Mr. Isaac Slater, in 1868 he commenced what proved to be his long connection with the Gloucester Railway Carriage and Wagon Company, Limited, of which his father was the general manager. Shortly after joining the staff he proceeded to Russia, where he acted as the company's representative. In 1884 he succeeded his father as general manager.

Personal.

MR. C. LATHAM has been elected a director of Swift, of Coventry.

MR. S. H. BRUETON, of the Midland Coal, Coke and Iron Company, Limited, has been appointed secretary to the Stafford Coal and Iron Company, Limited.

MR. G. L. MURRAY, of Leeds, formerly holding the position of works manager with Kerr, Stuart & Company, Limited, Stoke-on-Trent, has been appointed superintendent of the Locomotive, Carriage and Wagon Works of the Sudan Government Railways and Steamers.

MR. DOUGLAS VICKERS, president of Vickers, Limited, has resigned from the office of treasurer of the University of Sheffield owing to pressure of other work. It is proposed to elect in his stead Mr. W. Newton Drew, chairman of Newton, Chambers & Company, Limited.

Will.

HAMPTON, W. E., of St. Agnes Road, Moseley, Birmingham, ironfounder	£7,539
WESTON, SIR JOHN WAKEFIELD, BART., a director of Nobel Industries, Limited ...	£60,407
ROW, O. M., of Flixton, Lancs., chairman of Royles, Limited, engineers, of Irlam	£18,813
BAYLIS, A. B., of Springvale, Morthan, near Rotherham, chairman and managing director of the Midland Iron Company, Limited	£7,909
HAWKINS, W. R., of Burnt Tree, Tipton, Staffs, senior partner in Hawkins & Company, of Dudley Port, ironfounders	£22,044
IRONSIDE, E. A., of Walden Knowle, Chislehurst, proprietor of Ironside, Son, & Company, engineers and contractors, Grosvenor Place, S.W.	£49,764

Cupping Tests for Thin Metal Sheets.—At a recent meeting of the West of Scotland Iron and Steel Institute in Glasgow, a Paper on the cupping test for the determination of the drawing qualities of thin metal sheets was read by MR. GEORGE G. BEARD, who said that in the investigation of the test an endeavour was made to obtain a number known as the "ductility factor." This would give an indication of the drawing qualities of any thin material in the same manner as the Brinell number gave the quality of hardness of any material. Tests had been carried out to determine the relationship between the depth of an impression and the applied pressure, the impression being formed by means of forcing the metal into a die under oil pressure. By using a standard pressure and a die of definite dimensions, the ductility factor was determined by means of the relationship thus found.

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BUT DO YOU KNOW ?
WILL YOU ASK US TO PROVE IT ?

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BCM/GRC LONDON.

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THE FOUNDRY TRADES EQUIPMENT & SUPPLIES ASSOCIATION LTD.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—With abundant supplies of fuel from the Durham coalfield now in immediate view as the mines resume working, the question now most frequently debated in the Cleveland iron market is: how soon can production at the local blast furnaces become an accomplished fact once more? Upon a satisfactory answer to this question depends another important factor, viz., to what level pig-iron prices are likely to settle down until such time as fuel and other raw material costs can, at all events, be approximately ascertained. Generally, the feeling is that any period of high prices will be much shorter-lived than was at one time inspired, and it will be all to the good of industry if this should prove to be the case. For the present, at all events, pig-iron prices remain at last week's level, viz., No. 1, 125s.; No. 3 G.M.B., 120s.; No. 4 foundry, 119s.; and No. 4 forge, 118s. 6d. per ton.

The hematite position is, of course, largely governed by the conditions in the ordinary iron industry, but it is regarded as unlikely that there will be a restart on Tees-side of the furnaces producing the first-named quality much before the turn of the year. At present there is no hematite available for disposal, and prices are only nominal at from 87s. 6d. to 90s. per ton for East Coast mixed numbers. In the North-West Coast area prices are firm and strong, with an upward tendency.

LANCASHIRE.—Furnaces supplying foundry pig in this locality seem to be hopeful of accumulating material to enable them to make a start with deliveries by about the middle of January. With this in view, buyers are doing no more in the prompt market than satisfying very pressing needs. Their choice is restricted to Scottish No. 3, which is still offered in small lots at about 140s. per ton, Middlesbrough at 137s. 6d., off-grade hematite at 120s., and East Coast foundry iron at round 132s. 6d., in each case including delivery Manchester or equal.

THE MIDLANDS.—In South Staffordshire and the adjacent districts chief market interest is now centred on the earliest date at which supplies of pig-iron can be definitely obtainable. Meanwhile consumers have to be content with odd parcels on offer as follow:—Derbyshire at 85s. to 90s., and Northants in the region of 82s. 6d. to 85s. per ton, f.o.t. furnaces. A limited amount of Lincolnshire No. 3 is offered for delivery, in all probability early January, at about £5 2s. 6d. per ton, delivered local stations.

SCOTLAND.—Local consumers of foundry pig still maintain a reserved attitude, having decided that the present prices for No. 3 quality, from 115s. to 120s. at furnaces, are too high. There has also been quite a jump in the price of No. 3 foundry Continental iron to 93s. 6d. per ton f.o.t. Grangemouth, and in some instances 95s. is being asked, with iron not too plentiful.

Metals.

Copper.—The position of standard copper during the past week has evidenced little improvement upon its predecessors, business having been quiet owing to decreased consumptive demand, while the absence of buying on speculative account has been a further source of weakness. Forward selling predominated latterly, and prices closed near the worst, with a net loss of about 15s. from the best.

Official closing prices of standard copper have been as follow :—

Cash: Thursday, £56 15s. to £56 17s. 6d.; Friday, £56 15s. to £56 17s. 6d.; Monday, £56 17s. 6d. to £57; Tuesday, £56 10s. to £56 12s. 6d.; Wednesday, £56 12s. 6d. to £56 15s.

Three Months: Thursday, £57 10s. to £57 12s. 6d.; Friday, £57 10s. to £57 12s. 6d.; Monday, £57 12s. 6d. to £57 15s.; Tuesday, £57 5s. to £57 7s. 6d.; Wednesday, £57 7s. 6d. to £57 10s.

Tin.—In striking contrast to the conditions outlined in the copper section, the market for tin has developed further strength, quotations advancing for forward delivery, while heavy dealings were recorded at a substantial advance. The position of near tin has been severely tightened again, due to further encroachments of 342 tons on English stocks, which fell to the very low record of 1,248 tons. The premium on cash and near tin rose rapidly to over £11 a ton, and with indications of good statistics for the current month, the course of the market continues to be viewed in an optimistic light.

Official closing prices of standard tin have been as under :—

Cash: Thursday, £313 to £313 5s.; Friday, £315 10s. to £315 15s.; Monday, £320 to £320 5s.; Tuesday, £317 to £317 10s.; Wednesday, £314 10s. to £315.

Three Months: Thursday, £302 5s. to £302 10s.; Friday, £303 5s. to £303 10s.; Monday, £303 5s. to £303 10s.; Tuesday, £300 15s. to £301; Wednesday, £299 5s. to £299 10s.

Spelter.—The outlook in the market for ordinary spelter is now regarded as more satisfactory, prices having been fairly strong on bear covering and firmer American cable advices, while offers from the Continent have become more restricted. Consumers' needs in this country should be again on the increase, while at the same time smelting may be expected to be resumed as fuel supplies are now unrestricted.

The following are the week's prices :—

Ordinary: Thursday, £33 10s.; Friday, £33 12s. 6d.; Monday, £33 16s. 3d.; Tuesday, £33 12s. 6d.; Wednesday, £33 3s. 9d.

Lead.—Notwithstanding recent difficulties of consumers of soft foreign pig during a prolonged period, values have held up remarkably well, and despite occasional reductions, they are still about 30s. above the low point of last May, when prices were officially recorded at £27 7s. 6d per ton. Quotations are now very reasonable, and with the fuel position steadily improving, the consumption should also gradually expand.

The week's prices are appended :—

Soft foreign (prompt): Thursday, £29 5s.; Friday, £29 6s. 3d.; Monday, £29 7s. 6d; Tuesday, £29; Wednesday, £28 15s.

FOUNDRY BARROWS
THAT OVERCOME THE FAULTS EXISTING IN OTHER BARROWS.

The Cheapest Labour Saving Barrow Made.
Balanced so that Load is carried on the Wheel. Not on the Arm.
Obtain our Keen Prices.
THOS. VICKERS, Foundry Specialist,
14, NEW ST., BIRMINGHAM.

THE INTERNATIONAL FOUNDRY EQUIPMENT Co. LTD.
FOUNDRY PLANT AND EQUIPMENT ENGINEERS,
CANTON WORKS, YOUNG STREET, SHEFFIELD, Eng.

'EK' BRIQUETTES
FERROSILICON
FERROMANGANESE FERROPHOSPHORUS
ENSURES :—Definite percentage of added Silicon, Manganese or Phosphorus in the castings; Absence of the waste inevitable when the ordinary Ferro-Alloys are used; Simplicity in working; minimum of handling; exact working.
MADE IN THREE DISTINCT SHAPES
CYLINDER — CUBE — CONICAL
Quotation and List upon Application.

SPONGE CLOTHS
FOR ENGINEERS
Joshua Hoyle & Sons Ltd
Cotton Spinners and Manufacturers
50, PICCADILLY, MANCHESTER
Wholesale and Shipping only.

LET YOUR NEXT LOT OF BOXES BE STERLINGS

CAST IRON moulding Boxes, however well made, are liable to be cracked or broken at any moment. They are also exceedingly heavy. Heavy boxes slow down production, reduce the capacity of your Foundry, and impose unnecessary fatigue on your moulders.

* * *

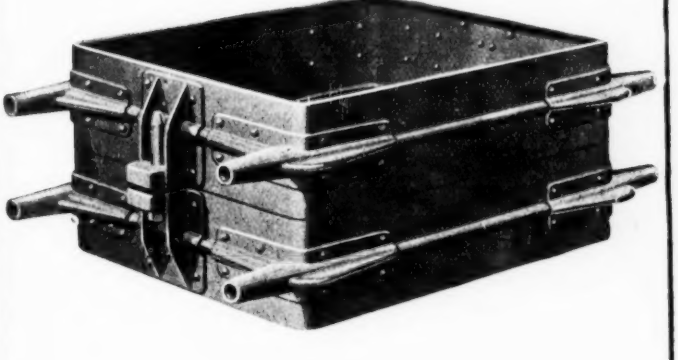
STERLING BOXES are light, easy to handle, strong, rigid, practically indestructible and are permanently accurate. Hence the popularity of STERLING BOXES.

* * *

You can't make a cast iron moulding box as STRONG as a STERLING without making it excessively heavy. You can't make a cast iron box as LIGHT as a STERLING without making it excessively fragile.

* * *

Ask the opinion of any of the 3,500 users of STERLING BOXES and make an honest comparison between STERLINGS and other types — your choice will be for STERLINGS every time.



STERLING FOUNDRY SPECIALTIES LTD.
BEDFORD.
London Office: 13, Victoria Street, S.W.1

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	56	12	6
Three months ..	57	7	6
Electrolytic	64	0	0
Tough	62	0	0
Best selected ..	62	15	0
Sheets	92	0	0
India	73	10	0
Wire bars	64	10	0
Do. December ..	64	5	0
Do. January ..	64	5	0
Ingot bars	64	5	0
H.C. wire rods ..	69	5	0
Off. av. cash, Nov.57	7	1	5/32
Do., 3 mths. Nov.58	3	11	5/11
Do., Sttlmnt Nov.57	6	11	2/11
Do., Electro. Nov.65	16	0	3/11
Do., B.S., Nov. 64	7	6	
Aver. spot price copper, Nov. .. 57	7	1	1/2
Do., wire bars, Nov.66	1	0	1/4
Solid drawn tubes			13d.
Brazed tubes ..			13d.
Wire			9¾d.

BRASS.

Solid drawn tubes ..	12d.
Brazed tubes	13¾d.
Rods, drawn	11¼d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10⅝d.
Wire	10½d.
Rolled metal	10½d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

Standard cash ..	314	10	0
Three months ..	299	5	0
English	312	10	0
Bars	317	0	0
Straits	326	10	0
Australian	321	0	0
Eastern	311	0	0
Banca	325	0	0
Off. avr. cash, Nov.309	9	1	15/32
Do., 3 mths., Nov.298	14	9	21/32
Do., Sttlmt. Nov.309	8	2	5/11
Aver. spot., Nov. 309	9	1	3/4

SPELTER.

Ordinary	33	3	9
Remelted	33	0	0
Hard	27	5	0
Electro 99.9 ..	36	0	0
English	34	2	6
India	30	0	0
Zinc dust	43	0	0
Zinc ashes	15	0	0
Off. aver., Nov. ..	33	9	8 11/16
Aver., spot, Nov.	33	9	10

LEAD.

Soft foreign ppt.	28	15	0
English	30	5	0
Off. average, Nov. 29	8	3	31/32
Average spot, Nov. 29	5	4	3/4

ZINC SHEETS, &c.

Zinc sheets, English	42	10	0
Do. V.M. ex whf.	39	10	0
Rods	45	0	0
Boiler plates ..	39	0	0
Battery plates ..	38	10	0

ANTIMONY.

Special brands, Eng.	74	10	0
Chinese	57	0	0
Crude	36	0	0

QUICKSILVER.

Quicksilver ..	17	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon —	
25%	9 2 6
45/50%	11 5 0
75%	17 10 0
Ferro-vanadium—	
35/40%	14/3 lb. va.
Ferro-molybdenum—	
70/75% c. free ..	5/- lb.
Ferro-titanium—	
23/25 % carbon-free	1 1½d.
Ferro-phosphorus,	20/25%, £17 0 0
Ferro-tungsten—	
80/85%, c.fr. ..	1/5 lb.
Tungsten metal powder—	
98/99% ..	1/9 lb.
Ferro-chrome—	
2/4% car. ..	£32 0 0
4/6% car. ..	£23 5 0
6/8% car. ..	£21 15 0
8/10% car. ..	£20 10 0
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£42 0 0
Max. 0.70% car.	£54 0 0
70%, carbonless	1/5 lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	8/6 lb.
Aluminium 98/99%	£104
Metallic Chromium—	
96/98% ..	3/- lb.
Ferro-manganese (net)—	
76/80%, loose	£16 0 0
76/80%, packed	£17 0 0
76/80%, export	£16 0 0
Metallic manganese—	
94/96%, carbonless	2/- lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten ..	s. d. 2 6
Finished bars, 18% tungsten ..	3 0
Per lb. net, d/d buyers' works.	
Extras—	
Rounds and squares 3 in. and over ..	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do. under ½ in. × ¼ in.	1/- lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra
Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.
Per lb. net, d/d steel makers' works.	

SCRAP.

South Wales—	£	s.	d.
Hvy. steel	2 17 6 to 3	10	0
Bundled steel & shrngs. ..	2	7	6
Mixed iron & steel	2 7 6 to 2	15	0
Heavy cast iron	2 15 0 to 2	17	6
Good machinery for foundries	3 3 6 to 3	7	6
Cleveland—			
Heavy steel ..	3	0	0
Steel turnings ..	2	7	6
Cast iron borings	2	5	0
Heavy forge ..	4	2	6
Bushelled scrap	3	10	0
Cast-iron scrap	3 11 6 to 3	15	0
Lancashire—			
Cast-iron scrap	3	10	0
Hvy. wrought ..	3	2	6
Steel turnings ..	1	17	6
London — Merchants' buying prices delivered yard.			
Copper (clean)..	48	0	0
Brass (clean) ..	38	0	0
Lead (less usual draft)	26	10	0
Tea lead ..	22	0	0
Zinc	23	0	0
New aluminium cuttings ..	82	0	0
Braziery copper	44	0	0
Gunmetal ..	46	0	0
Hollow pewter	190	0	0
Shaped black pewter ..	140	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast –	
Foundry No. 1 ..	125/-
Foundry No. 3 ..	120/-
Foundry No. 4 ..	119/-
Forge No. 4	118/6
Hematite No. 1 ..	—
Hematite M/Nos. ..	—
N.W. Coast—	
Hem. M/Nos. d/d Glas.	—
„ d/d Birm. ..	—
Midlands —	
Staffs common* ..	—
„ No. 4 forge ..	—
„ No. 3 foundry	—
Shrops. basic	—
„ Cold blast, ord.*	—
„ „ roll iron* ..	—
* d/d Birmingham.	
Northants forge	—
„ fdry No. 3 ..	—
Derbyshire forge ..	—
„ fdry. No. 3 ..	—
„ basic	—
Scotland—	
Foundry No. 1 ..	—
„ No. 3 ..	117/6
Hem. M/Nos. ..	—
Sheffield (d/d district)—	
Derby forge	—
„ fdry. No. 3 ..	—
Lincs. forge	—
„ fdry. No. 3 ..	—
E.C. hematite	—
W.C. hematite ..	—
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3.. ..	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
„ fdry. No. 3 ..	—
Northants foundry No. 3	—
Dalzell, No. 3	140/-
Summerlee, No. 3 ..	140/-
Glengarnock, No. 3 ..	—
Gartsherrie, No. 3 ..	140/-
Monkland No 3	140/-
Coltness, No. 3	140/-
Shotts, No. 3	140/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.) nom. ..	12 10 0 to 16	0 0
Angles		—
Tees to 3 united ins.		—
Nut and bolt iron		—
Hoops	14 10 0	
Marked bars (Staffs.) f.o.t. ..		—
Gas strip	12 10 0	
Bolts and nuts .. ¾ in. × 4 in. ..	15 5 0	
Steel—		
Ship plates	8 12 6	
Boiler plts. ..	11 5 0	
Chequer plts. ..	9 15 0	
Angles	7 17 6	
Tees	8 17 6	
Joists	7 17 6	
Rounds and Squares 3 in. to 5½ ins. ..	8 10 0	
Rounds under 3 in. to ⅜ in. (Untested)	9 0 0 and upwards	
Flats, over 5 in. wide and up ..	9 10 0	
Flats, 5in. to 1½in.	8 10 0	
Rails, heavy ..	8 10 0	
Fishplates	12 10 0	
Hoops (Staffs.) ..	10 10 0	
Black sheets, 24g.	12 12 6	
Galv. cor. sheets, 24g.	17 10 0	
Galv. fencing wire 8g. plain	12 10 0	
Billets, soft	7 0 0 to 7 5 0	
Billets, hard ..	—	
Sheet bars	7 10 0	
Tin bars d/d.. ..	7 10 0	

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to 10 w.g. ..	1	3½
Wire	1	4
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	23.26
No. 2 foundry, Valley	19.00
No. 2 foundry, Birm.	20 00
Basic	20.26
Bessemer	21.76
Malleable	20.76
Grey forge	20.26
Ferro-mang. 80% d/d	100 00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 24..	3.00
Sheets, galv., No. 24 ..	3.85
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb box	$5.50

COKE (at ovens).

Welsh foundry	—
„ furnace	—
Durham & North.	
„ foundry	—
„ furnace	67/-
Other Districts, foundry	—
„ „ furnace (basis)	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20 × 14, box	25/-
„	28 × 20, „	50/-
„	20 × 10, „	—
„	18¾ × 14, „	—
C.W.	20 × 14, „	—
„	28 × 20, „	—
„	20 × 10, „	—
„	18¾ × 14, „	—

Terneplates 28 × 20, — per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£18/10 to £19/0
Rolled Ord.	£15/10/0 to £16
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 0 0 to £6 10 0

all f.o.b. Gothenburg

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes	*Fittings*
Gas ..	60%	.. 50%
Water ..	55%	.. 45%
Steam ..	50%	.. 40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Nov. 25	56	15	0	dec. 2/6
,, 26	56	15	0	No change
,, 29	56	17	6	inc. 2/6
,, 30	56	10	0	dec. 7/6
Dec. 1	56	12	6	inc. 2/6

Electrolytic Copper.

	£	s.	d.	
Nov. 25	65	0	0	No change
,, 26	65	0	0	,, ,,
,, 29	64	15	0	dec. 5/-
,, 30	64	0	0	,, 15/-
Dec. 1	64	0	0	No change

Standard Tin (Cash).

	£	s.	d.	
Nov. 25	313	0	0	No change
,, 26	315	10	0	inc. 50/-
,, 29	320	0	0	,, 90/-
,, 30	317	0	0	dec. 60/-
Dec. 1	314	10	0	,, 50/-

Tin (English ingots).

	£	s.	d.	
Nov. 25	311	0	0	No change
,, 26	313	10	0	inc. 50/-
,, 29	318	0	0	,, 90/-
,, 30	313	0	0	dec. 190/-
Dec. 1	312	10	0	,, 10/-

Zinc Sheets (English).

	£	s.	d.	
Nov 25	42	10	0	No change
,, 26	42	10	0	,, ,,
,, 29	42	10	0	,, ,,
,, 30	42	10	0	,, ,,
Dec. 1	42	10	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Nov. 25	33	10	0	No change
,, 26	33	12	6	inc. 2/6
,, 29	33	16	3	,, 3/9
,, 30	33	12	6	dec. 3/9
Dec. 1	33	3	9	,, 8/9

Lead (English).

	£	s.	d.	
Nov. 25	30	15	0	No change
,, 26	30	15	0	,, ,,
,, 29	30	15	0	,, ,,
,, 30	30	10	0	dec. 5/-
Dec. 1	30	5	0	,, 5/-

AVERAGE PRICES OF STEEL RAILS.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1908	6 2 6	6 0 0	6 0 0	5 15 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 16 3
1909	5 5 0	5 5 0	5 5 0	5 0 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0
1910	5 5 0	5 7 6	5 7 6	5 7 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 8 11½
1911	5 15 0	5 15 0	5 15 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 13 1½
1912	5 13 1	5 15 0	5 15 0	5 15 7	6 1 6	6 6 3	6 7 6	6 8 0	6 11 3	6 12 6	6 12 6	6 13 9	6 4 4
1913	6 15 0	6 14 4½	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	6 12 0
1914	6 10 0	6 10 0	6 6 3	6 0 0	6 0 0	6 0 0	5 14 0	6 2 6	6 13 9	6 12 0	6 7 6	6 7 6	6 5 3½
1915	6 10 6	6 17 6	7 5 0	7 12 6	7 12 6	7 17 6	8 17 6	9 2 6	9 2 6	9 2 6	9 7 6	10 10 6	8 6 6½
1916	10 19 4	11 0 0	11 0 0	10 18 9	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 9 10
1917	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6
1918	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6
1919	10 17 6	13 7 6	13 7 6	13 7 6	15 0 0	15 10 0	16 0 0	16 10 0	16 10 0	16 10 0	16 10 0	17 5 0	14 12 11
1920	18 15 0	19 5 0	20 7 6	22 0 0	23 0 0	23 0 0	24 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	22 18 11½
1921	23 5 0	20 4 0	18 0 0	17 0 0	15 0 0	15 0 0	14 0 0	14 0 0	14 0 0	11 12 6	10 10 0	10 0 0	15 4 3
1922	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 0 0	8 15 0	8 15 0	8 15 0	8 15 0	9 4 2
1923	8 17 6	9 2 0	10 5 0	10 10 0	10 10 0	10 10 0	9 15 0	9 0 0	8 15 0	8 15 0	8 19 0	9 5 0	9 9 10
1924	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 2 6	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 2 3½
1925	9 0 0	9 0 0	9 0 0	9 0 0	8 15 0	8 10 7½	8 10 0	8 10 0	8 10 0	8 4 9	8 0 0	8 0 0	8 11 7½
1926	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	—	—	—

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE AT MIDDLESBROUGH.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1915	83 11	88 6	94 8	107 0	102 6	101 3	98 9	98 7½	96 6	104 0	124 1	130 0	106 11½
1916	133 9	140 0	136 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	128 1½
1917	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1918	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1919	122 6	122 6	122 6	122 6	179 2	190 0	197 6	200 0	200 0	200 0	200 0	200 0	171 4
1920	220 0	220 0	240 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	251 8
1921	240 0	220 0	180 0	180 0	180 0	160 0	160 0	160 0	137 0	127 6	117 6	104 6	162 2
1922	97 6	91 7½	100 0	98 6	97 1½	94 7	93 6	90 9	89 7	91 10½	93 0	93 2	94 5½
1923	94 6	104 9	122 0	126 10½	122 0	115 3	107 0	98 8½	98 10½	99 1½	100 6½	102 3	107 10½
1924	102 4½	101 3	99 7½	99 0	98 9½	97 4½	95 3½	93 1½	90 7½	88 0	88 4½	88 6	95 2½
1925	87 5	85 9	84 7½	82 6	80 10½	79 3	77 1½	75 7½	75 0	74 3½	74 9	76 0	79 5½
1926	77 3	77 9	77 3½	76 3	77 4½	78 0	79 8½	81 9	83 4½	87 7½	—	—	—

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